U.S. DEPARTMENT OF COMMERCE
National Technical Information Service
PB-276 555

Disposal of Hazardous Wastes Recommended Procedures for Hazardous Waste Management

NATO Comm on the Challenges of Modern Society, Brussels, Belgium

Prepared for

Environmental Protection Agency, Washington, D C

Jun 77

PB 276 555

NATO CCMS

OTAN CCMS

COMMITTEE ON

THE CHALLENGES OF

MODERN SOCIETY

DISPOSAL OF HAZARDOUS WASTES

RECOMMENDED PROCEDURES FOR HAZARDOUS WASTE MANAGEMENT

Number 62

NORTH ATLANTIC TREATY ORGANIZATION

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U. S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO. NATO/CCMS-62	2.	3. RECIPIENT'S ACCESSION NO. PB276555
4. TITLE AND SUBTITLE Disposal of Hazardous Wastes - Recommended Procedures for Hazardous Waste Management		5. REPORT DATE June 1977
		6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S)		8. PERFORMING ORGANIZATION REPORT NO.
9. PERFORMING ORGANIZATION NAME AND ADDRESS Same as Box 12		10. PROGRAM ELEMENT NO.
		11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS NATO Committe on the Challenges of Modern Society, Brussels, Belgium		13. TYPE OF REPORT AND PERIOD COVERED
		14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

16. ABSTRACT

This Sub-Project on Recommended Procedures for Hazardous Waste Management is focused on implementation topics or issues that arise from consideration of the options for an integrated hazardous waste managemnet program by a country. These topics tend to group themselves around (1) the identification of hazardous wastes and (2) the authorization for operation of hazardous waste facilities. Although definitive conclusions in each sub-topic are often not apparent, comparisons and contrasts between the concepts utilized by participating countries can provide useful insights for others interested in alternative approaches to these concepts

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS *(This Report)*	21. NO. OF PAGES 102
	20. SECURITY CLASS *(This page)*	22. PRICE A06, A01

EPA Form 2220-1 (9-73)

Pilot Study

Disposal of Hazardous Wastes

Recommended Procedures for Hazardous Waste Management

Report prepared by the United States of America

and Canada

Committee on the Challenges

of Modern Society

North Atlantic Treaty Organization

June 1977

This report is printed on recycled paper

CONTENTS

SUMMARY AND CONCLUSIONS - 1

PART I
U.S. ENVIRONMENTAL PROTECTION AGENCY

I. INTRODUCTION AND BACKGROUND - - - - - - - - - - - - - - - - - - 4

II. HAZARDOUS WASTE DEFINITION - - - - - - - - - - - - - - - - - - 8

III. WASTE SAMPLING AND ANALYSIS - - - - - - - - - - - - - - - - - -29

IV. SITE SELECTION (INCLUDING CITIZEN ACCEPTANCE) - - - - - - - -41

V. LONG-TERM CARE -66

BIBLIOGRAPHY -75

PART II
ENVIRONMENT CANADA

VI. PERMIT PROCESSES -79

VII. LABELING -87

VIII. FACILITY SAFETY -94

Summary and Conclusions

The five topics chosen by participating countries for Part I of the Recommended Procedures for Hazardous Waste Management Sub-Project are presented by chapter as follows: Introduction and Background, Hazardous Waste Sampling and Analysis, Site Selection, Long-Term Care, Permit Processes, Labeling, and Facility Safety.

The Introduction and Background chapter presents the overall framework of the paper and sets the tone of this international comparison of the elements of hazardous waste management control systems. Exhibit 1 (page 7), "An Integrated Hazardous Waste Management Program," portrays the fundamental concepts and options that the participating countries may collectively encompass in their hazardous waste management schemes.

In the next chapter, the issue of defining hazardous waste is discussed from two perspectives--i.e., the existing statutory definitions as well as any regulatory definitions are considered. In general, all countries begin from a similar basis in identifying harmful waste characteristics in their statutory definitions. The definitions are displayed in Exhibit 2 (pages 10-11). The international consensus that these wastes are capable of damage to the environment and to public health, and that controls on their ultimate disposition are required, becomes immediately clear in these broader definitions.

On the regulatory level, there appear to be two basic approaches in refining the definition of hazardous waste--the list approach and the criteria approach. In all cases, some form of a list is the end result of the regulation. Exhibit 3 (pages 25-28) compares the existing lists of the participating countries. In the final analysis, a consensus of

participating countries on a common hazardous waste list appears infeasible due to basic differences in hazardous waste management technology, political and economic structures of the various governments, and the present lack of information on the properties of many wastes.

Chapter III is a discussion of the member countries' waste sampling and waste analysis techniques. From the input received, there seem to be no validated, standardized waste sampling protocols in use. While more progress has been made on the problem of waste analysis, it also is far from being solved--complications with pretreatment of the samples and separation techniques make results often difficult to interpret. From the discussion it is obvious that much work needs to be done in both of these areas.

In Chapter IV, it is apparent that approaches to site selection from the participating countries are generally less well developed than approaches to the definition issue. Not all countries have a formalized site selection process. Those that do, have found it necessary to use some type of systematic plan to choose their sites, such as a matrix, a decision tree, or interpretation of field data. Site selection criteria are compared in Exhibit 4 (pages 60-65), which shows soil characteristics and groundwater conditions to be the physical factors of greatest concern. Not to be overlooked as part of the site selection process is citizen acceptance of the hazardous waste facility. A separate section of the chapter is devoted to this important topic.

Chapter V shows that long-term care, like site selection, is a relatively undeveloped area of consideration by the NATO countries. The two systems in use today are: 1) guaranteeing a secure site via a stringent licensing system, and 2) consideration of financial arrangements

to assure long-term care. Comprehensive provisions for long-term care will necessarily include both of these provisions, not just one or the other.

In Chapter VI, Facility Permits, the conclusion is that it is not possible to design one permit that will suit all situations for the control of disposal facilities due to the variety of facilities and the different national and regional forms of legislation. It is generally recognized, however, that disposal facility performance permits are necessary to control facility safety, waste products allowed for disposal, facility capacity, waste-specific disposal methods, effluent and emission criteria, and the record of disposed wastes. The trip ticket is regarded as a valuable control tool in maintaining the identity of the waste from production to ultimate disposal and in aiding decisions for hazardous waste disposal.

The purpose of labeling containers, as outlined in Chapter VII, is to indicate on waste products the nature and degree of hazard associated with the product, and any special handling and disposal procedures which may be required if the product is to be handled by second or third parties. As a minimum, the label should provide the manufacturer's or producer's name and address and a description of the container contents.

Facility Safety, Chapter VIII, can be summarized by saying that the technology and techniques for handling hazardous wastes are essentially the same as handling other hazardous commodities, but the degree of uncertainty is much greater and, therefore, a proportionate increase in safety precautions should be taken at hazardous waste management facilities.

I. Introduction and Background

In identifying significant topics that should be addressed in this Sub-Project, the participating countries desired to have a contextual framework which outlines the fundamental principles of effective hazardous waste management. With this framework in focus, the significance of each of the topics selected can be shown.

Exhibit 1, An Integrated Hazardous Waste Management Program, describes an idealized flow of options for managing hazardous wastes from the point of generation through a variety of reduction, treatment, and recovery options to ultimate disposal. Each country has a different view as to the priority and emphasis to be placed on any of the succession of options. This view is based upon the set of cultural, economic, socio-political, and environmental traditions and attitudes held in that country. The Sub-Project countries, however, feel that all of the options described should be mentioned in order to portray the scope and range of opportunities that exist for managing the hazardous waste problem.

The ordering of options in Exhibit 1 is also of significance. The conscientious examination of the processes that generate waste in order to minimize the quantity of hazardous residuals, the transfer of waste materials as raw materials, and the careful consideration of material and/or energy recovery potentials reflect not only concerns for environmental and public health, but also a resource conservation ethic. It is <u>after</u> the consideration of these conservation options that the participating countries endorse the exploration of environmentally sound treatment and

disposal options which are technologically feasible and economically sound for the country considering them.

With the program suggested in Exhibit 1 as a background for common understanding, the countries participating in the Sub-Project on Recommended Procedures for Hazardous Waste Management identified several topics that were particularly challenging or complex in the implementation of such national programs.

National and sub-national approaches to identifying, defining, and classifying hazardous waste are of major concern. Different methodologies have been developed to serve differing needs in each country. Essential to identifying such wastes are techniques for sampling and analyzing waste streams. Although waste water and air pollution sampling and analysis have progressed relatively far in several countries, similar techniques for analyzing solid, liquid, and contained gaseous wastes have not been well-developed. In addition, the post-identification labeling of waste material is an issue of concern. The kind and detail of information needed is a significant question as is the types of labels, their longevity on certain containers, and the compatibility of such waste labels with other national commodity labeling systems--either industrial or governmental.

A second focus of concern for the participating countries is on the selection, creation, operation, closing, and post-closure care of hazardous waste management facilities--especially land disposal sites.

Techniques for rationalizing the selection of potential sites and their acceptability to the general public are of continuing concern. Such site selection can be an independent process or a part of formal permit/license granting procedures. The countries also see a need to exchange information on the administrative procedures, forms and conditions which typically are used in permitting such facilities.

Safety of operations at such facilities is also of interest; an effort has been made to collect information on facility safety that is unique or supplemental to safety principles already practiced by chemical manufacturing facilities. A final topic is the nature of mechanisms used in each country to monitor the long-term integrity of land disposal facilities. That is, what financial and institutional arrangements are made, if any, at the time of permitting a site to provide groundwater monitoring and other checks for environmental contamination?

In summary, the Sub-Project on Recommended Procedures for Hazardous Waste Management is focused on implementation topics or issues that arise from consideration of the options for an integrated hazardous waste management program by a country. These topics tend to group themselves around (1) the identification of hazardous wastes and (2) the authorization for operation of hazardous waste facilities. Although definitive conclusions in each sub-topic are often not apparent, comparisons and contrasts between the concepts utilized by participating countries can provide useful insights for others interested in alternative approaches to these concepts.

Exhibit 1

AN INTEGRATED HAZARDOUS WASTE
MANAGEMENT PROGRAM

Management of hazardous wastes means the organized, systematic channeling of wastes through pathways to assure their appropriate disposal with acceptable public health and environmental safeguards.

Fundamental to any hazardous waste management planning are attempts to reduce wastes at the source through process changes and modifications in light of appropriate economics. To the extent that wastes are already minimized, separation and concentration of hazardous wastes are also important in order to reduce special handling and management requirements and increase reuse opportunities. Such concentration will occur as air and water pollution control systems remove noxious pollutants from fluid waste streams.

An important option in hazardous waste management is the concept of a hazardous waste clearinghouse, that is, to use the waste as is (if possible). One man's waste can be another man's feedstock. Minor process modifications enhance the possibilities for exchange as well. The clearinghouse concept is already being utilized in more than 13 countries including Austria, Belgium, Canada, Denmark, Finland, France, Netherlands, Norway, Sweden, Switzerland, Federal Republic of Germany, United Kingdom and the United States.

As some hazardous wastes contain valuable basic materials, material recovery makes sense as a next step from both resource conservation and environmental viewpoints. As material shortages become more widespread, material recovery from hazardous waste will become more economically attractive.

If the hazardous wastes cannot be used or materials recovered from them, and if they can be safely burned, destruction by incineration with energy recovery would be the next desired alternative with due consideration for residual disposal. Traditional land-based incineration as well as shipboard combustion of wastes are options considered viable in several countries. Nonburnable wastes should be detoxified and neutralized by physical, chemical, or biological treatment, when necessary and feasible, to reduce special handling and management requirements and minimize the amounts of toxic materials destined for land disposal. The need for such treatment may be a function of economic constraints and local conditions in certain countries.

For hazardous wastes requiring land disposal, volume reduction to minimize land use requirements may be desirable. The use of mines (isolated underground areas) can be a reasonable method for disposal of selected wastes. Isolation techniques (such as encapsulation) may be necessary prior to land burial in specially designated landfills in order to assure environmental integrity of the landfill site.

II. Hazardous Waste Definition

Central to any program to manage hazardous waste are the definitional limits on those waste materials controlled by the management system and those outside of it. These definitions are designed to suit the nature of the environmental problem to be solved as well as the socio-political and economic conditions existing in each country.

In analyzing the issue of definition, the participating countries observed that there were multiple levels of sophistication in identifying what is a hazardous waste. At the statutory level, legislatures and parliaments choose a few phrases to broadly define hazardous wastes and their detrimental public health and environmental effects. Next, at the regulatory level, government agencies further elaborate upon and interpret these broad definitions to produce more specific examples, criteria, categories, or listings of hazardous wastes. Finally, in order to implement those administrative orders and regulations, sub-national and local governments and industry must have operational rules, tests, and methods by which to translate regulatory definitions into practice for surveillance and enforcement purposes.

The principal purpose of this section is to briefly examine statutory definitions as background information and then to compare and contrast regulatory definition schemes. Implementation definitions go beyond the scope and level of detail possible in this sub-project. Recommendations as to an "optiomal" scheme of definitions are not possible given differences between countries, but conclusions as to similarities and differences of schemes will be attempted.

A. Statutory Definitions

During the last five years, all participating countries have recognized the hazardous waste disposal problem and a number of countries have passed legislation to cope with these potentially dangerous residuals. Exhibit 2, Statutory Definitions, highlights the wording of the basic waste management laws in several of the participating countries.

In general, one major theme pervades these statutory definitions. Harmful effects or pollution as the result of a disposal act are the major criteria. Both human health and the environment are specifically cited in France, the United Kingdom, and the United States as possible receptors of negative effects. In Germany and the United Kingdom, wastes with potential hazard are considered "special wastes," and they are part of a larger statutory scheme requiring planning for and notifications of actions relative to a wider range of wastes. In France, the FRG, Netherlands, the United Kingdom, and the United States, chemical, hazardous, or special wastes must be or have been identified, and these wastes are subject to a broad system of regulations.

Thus, all countries begin from a relatively similar statutory basis as to what characteristics of wastes should be of concern. Words such as "noxious," "difficult," "dangerous," "detrimental," "injurious," "poisonous," "polluting," and "degrade," appear throughout the enabling legislation. It is clear that an international consensus exists that certain waste materials--whether solid, liquid, sludge, or contained gas--are capable of damage to the environment and public health and that controls on their ultimate disposition are required.

Exhibit 2

Statutory Definitions

France - ... categories of waste may be defined by decree and the enterprises that produce, import, transport or dispose of wastes which belong to these categories and which are in a state such that they cause, or at the time of their disposal may cause, a nuisance such as ... injurious effects on the soil, plants, or animals, to degrade the scenery or the countryside, to pollute the air or water, to create a noise or odor, or, ...[are] harmful to human health or the environment... (Art. 8 and 2; Law No. 75-633; July 16, 1975).

Federal Republic of Germany - Special wastes are such wastes from commercial or trade companies which due to their nature, composition, or quantities are especially hazardous to human health, air, or water, or which are explosive, flammable, or may cause diseases. Their disposal must be subject to additional requirements according to the Act. (Federal Act on the Disposal of Waste, 1972, as amended, 1976).

Netherlands - Chemical wastes are: (1) wastes consisting wholly or partly of chemicals indicated by General Administrative Order and (2) wastes produced by chemical processes designated by General Administrative Order. (Chemical Waste Act, 1977).

United Kingdom - Waste "of a kind which is poisonous, noxious or polluting and whose presence on the land is liable to give rise to an environmental hazard." (Deposit of Poisonous Waste Act, 1972); Special wastes are those which "may be...dangerous or difficult to dispose of" (Control of Pollution Act, 1974).

United States - Hazardous waste means a "solid waste or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (A) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible, illness, or (B) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." Solid waste includes "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semisolid, or contained gaseous material..." (Resource Conservation and Recovery Act of 1976).

B. Regulatory Definitions

Several of the member countries have submitted legislation, regulations, or hazardous waste classification schemes that have either been passed as law or are preliminary documents for establishment of their hazardous waste lists. Discussed below are the current classification systems for Denmark, the EEC, the Federal Republic of Germany, France, Netherlands, the United Kingdom, and the United States (California).

Denmark

A list of 39 chemical wastes had been written as of December 1976. Two general criteria are given for the choice of wastes; they are: "1) being hazardous to the environment and people, and 2) arising in significant quantities."

The majority of entries on the list are industry- or process-specific wastes; the remainder are groups of chemical compounds. No individual hazardous chemicals are listed; i.e., the list is not a detailed one.

EEC

The Commission of European Communities has submitted to the Environment and Consumer Protection Council of Ministries for decision a Proposal for a Council Directive on Toxic and Dangerous Waste. Sensing a need for a uniform code of hazardous waste disposal within the Community, the Commission has proposed a list of Toxic and Dangerous Wastes to be adopted by the Member States, so as to avoid any "distortion of competition" created by any existing or envisaged national hazardous waste regulations of the EEC's member countries. The Directive will assume a common legal

and administrative basis for the management of Toxic and Dangerous Wastes within the nine member countries of the European Community.

Toxic and Dangerous Wastes are defined by Article I and the Annex of the Draft Directive, which is a 20-item list of chemical compound groups. Article I(b) is worded as follows: "Toxic and dangerous waste means any waste containing or contaminated by the substances or materials listed in the Annex to this Directive of such nature, in such quantities, or in such concentrations as to constitute a risk to health or the environment." The list is the "result of preparatory studies carried out by the Commission in cooperation with national experts." Specifically excluded from the Directive are: radioactive waste; animal carcasses and agricultural waste (of fecal origin) used in farming; explosive substances; hospital waste; waste waters; gaseous effluents; and, other waste covered by specific community rules.

Federal Republic of Germany

In the Federal Republic of Germany a guideline "waste catalogue" has been in existence since 1975 containing all imaginable types of wastes. Some of the States (Lander) took various approaches to introduce a classification scheme from this general catalogue to separate out hazardous wastes by such schemes as: (1) choosing classes of hazard and noting minimum quantities of each waste class, (2) orienting hazardous waste class to the kind of disposal procedures, and (3) choosing as "hazardous," wastes not suitably co-disposed with residential waste (based on operational and/or physical/chemical parameters of the waste). As a consequence, a waste considered could be a special waste in one State, but not another. Problems arose where waste producers were bound locally, but transportation and disposal facilities necessarily operated across State borders.

The Act for an amendment to the Waste Disposal Act (July 21, 1976) generally defines "special wastes" although the term is not mentioned in the definition: "Following the present law, disposal of wastes from commercial or trade companies which due to their nature, composition, or amount, are especially hazardous to human health, air, or water; which are explosive, flammable, or may cause contagious diseases, is subject to additional requirements." Wastes following the above definition are defined and listed by the Federal Government under consent of the Bundesrat (Federal Council) by means of a regulation, which is effective as of June 1, 1977. The list will provide minimum, uniform standards for the Lander primarily with respect to waste stream control (notification, etc.).

The regulation includes a list of 35 types of waste streams (the so-called "hard core" of special wastes), and includes information on origin (manufacturing process) and major chemical constituents. One criterion for compiling the list is that quantity should be introduced into the classification by implication only; that an industry waste stream is listed should be sufficient to indicate which trades contribute wastes that contain significant enough amounts of a certain chemical that those wastes should be considered hazardous. (The purpose of this premise is to avoid over-control of industries that may produce an insignificant amount of a substance that would only be considered hazardous in large amounts.)

Other criteria used for the establishment of this list were: 1) the special wastes identified in the Waste Catalogue by the Lander; 2) that the wastes not be chosen if they are compatible with domestic wastes for

disposal or because their disposal may be technologically difficult; 3) the amount of chosen special wastes should possibly cover a major portion of the estimated 3 million tons of hazardous wastes generated in the Federal Republic of Germany annually. In summary then, the Federal Republic of Germany's hazardous waste identification scheme will consist of an industrial waste stream list chosen from the Waste Catalogue, to be implemented as a minimum list by all Lander.

France

Categories of waste may be "defined by decree" according to Title III, Article 8, of the Waste Disposal and Materials Recovery Law. "Waste" is defined in the General Provisions of the Law as "any material substance produced as a residue of a process of production, of transformation, or of utilization, or more generally, all moveable goods which have been abandoned or whose holder plans to abandon them." A draft Decree has been prepared that establishes five groups of these wastes; to be included is a list published pursuant to the provisions of Article L231-6 of the Labor Law.

The first category consists of chemical compound groups as well as a list of some 200 specific chemicals provided by the Labor Law. The second category consists of radioactive containing substances; the last three categories are comprised of selected industry-specific wastes. No particular criteria are set forth in the decree to explain the five categories of wastes.

Netherlands

The Chemical Waste Act which has passed Parliament refrains from defining the term chemical wastes, but calls for a List of Materials and

a List of Processes to be established; the contents of both lists shall constitute "chemical waste," provided that certain concentration limits are exceeded. The List of Materials is comprised of elements and compounds whose concentrations are toxic or persistent to man, animals, or plants; the List of Processes is an industry-specific list of wastes which contain elements or compounds from the List of Materials.

The List of Materials is divided into four classes. Class A includes mercury, cadmium, and their compounds, and other compounds whose harmful effects on the environment are more or less comparable to mercury and cadmium. While toxic characteristics place some substances on the list, the properties of persistency and bioaccumulation make others hazardous to the environment. Thus, a low concentration of these materials (50 mg. per kg.) in the environment makes them harmful due to these characteristics.

Class B is subdivided into groups BI and BII. The materials in BI are comparable heavy metal compounds whose harmful properties occur in higher concentrations of the compounds than in the metals of class A; the concentration in which they are considered a chemical waste is higher, i.e., approximately 5000 mg/kg. Also included in group BI are organic compounds whose extraction, manufacture, or synthesis is industry-related. Polymerized compounds are not included in the group. Group BII covers elements or compounds that release acute volatile toxic materials when they contact water.

Class C is comprised mainly of inorganic materials whose compounds occur in 20,000 mg/kg. Some organic compounds with the same limitations as in group BI are included in this class also.

Reactive elements and compounds (except for sulfur) that toxicologically are not so harmful make up class D, as well as inorganic acids bearing corrosive properties (concentrations of 50,000 mg/kg).

Some compounds may fall into one or more groups under this system of classification. When such is the case, the lower concentration for the compound is taken as the upper permissible limit.

The Process List provides a complementary cross-index for the Materials List. For every waste that is included, the constituents of the waste are contained in the Materials List. The Process List contains an enumeration of several processes, and laboratories, which is expected to classify any new hazardous waste that might be produced, since new wastes can be expected to first come from a laboratory.

United Kingdom

The Control of Pollution Act of 1974, which applies to all wastes deposited on land, has given the Secretary of State the authority to establish regulations for the disposal of "special waste," which is defined as "'controlled waste'... that may be so dangerous or difficult to dispose of, that special provision...is required for the disposal of waste of that kind by disposal authorities..." (Section 17.1). Section 30.1 defines "controlled waste" as "household, industrial and commercial waste or any such waste."

Regulations and classification of special wastes have not yet been established; under consideration, however, is a preliminary List of

Wastes Subject to Investigation. This list is comprised of 20 waste categories and their industrial origins. The criteria used to establish the list were to some extent "toxicity, polluting or other characteristics..." that ".... might require special controls to be exercised or preferred methods of treatment and disposal recommended, depending on concentrations, circumstances, etc." Additionally, all wastes established by the Deposit of Poisonous Waste Act that are "poisonous, noxious, or polluting" will probably be classified as a Special Waste, excluding the exempted wastes of the Act.

A detailed categorization of "difficult wastes" has been published as well as a 12-category broader classification scheme. The Broad Classification of Wastes for Record-Keeping Purposes partly is a process-specific list, whereas the finely divided Classification of Difficult Wastes contains groups and subgroups of specific chemical compounds and groups of process-specific wastes and their subgroups. These lists have been provided for licensing and waste survey purposes only, so the United Kingdom official classification of "special wastes" is still yet to be established.

United States of America

The Resource Conservation and Recovery Act of 1976, calling for the regulation of hazardous waste, became law on October 21, 1976. Within 18 months, the U.S. Environmental Protection Agency must promulgate regulations for hazardous waste disposal.

Although still being developed, the present Federal approach involves a two-phase procedure to allow the waste generator to quickly and easily

ascertain if he has a "hazardous waste." First, a set of inexpensive standard tests for acute hazards would be performed; candidate qualities specified in the law for testing include flammability, corrosivity, explosivity, etc. Second, a test to help predict the leaching behavior of the waste in the landfill environment is being considered as an indicator of potential long-term effects on groundwater.

This leaching test would specify a simple, inexpensive set of liquids, representative of landfill environments, which would be applied to waste samples. Leachate from the samples may be analyzed for toxicity or for certain substances in prescribed concentrations. The selection of the representative liquids and the levels of analysis are the subject of on-going consideration.

In the United States, a few States have adopted a "criteria" approach to defining hazardous waste based on acute hazards (derived from standard tests). As an example of State legislation, the State of California program is considered below.

Section 25117 of the California Health and Safety Code defines a Hazardous Waste as "any waste material or mixture of wastes which is toxic, corrosive, flammable, an irritant, a strong sensitizer; which generates pressure through decomposition, heat or other means; if such a mixture of wastes may cause substantial personal injury, serious illness or harm to wildlife, during, or as a proximate result of any disposal of such wastes or mixture of wastes." Furthermore, in section 25115 of the Code, an Extremely Hazardous Waste is defined as "any hazardous waste or

mixture of hazardous wastes which, if human exposure should occur, may likely result in death, disabling personal injury or illness during, or as a proximate result of, any disposal of such waste or mixture of wastes because of its quantity, concentration, or chemical characteristics."

The terms "corrosive," "flammable," "irritant," and "strong sensitizer" are in turn defined by the older California Hazardous Substances Act (chapter 13) by specific quantitative criteria. Theoretically, the tests can be applied to any waste with unknown constituents, and if the waste meets any of the criteria, it can be considered hazardous.

The California Law additionally calls for the establishment of hazardous waste lists compiled from the application of the above criteria. The regulations pursuant to the law have thus classified wastes in such a manner; a Hazardous Waste List and a Generic List of Wastes have been established. The Hazardous Waste List is an alphabetized inventory of all chemical compounds that have been determined to be hazardous or extremely hazardous as defined by the Health and Safety Code. The Generic List is a shorter enumeration of industry- and process-specific wastes that have been determined to be hazardous or extremely hazardous materials, whose constituents are those in the Hazardous Waste List.

C. Discussion

It appears that there are basically two regulatory approaches for establishing a country's classification of hazardous wastes--the list approach and the criteria approach.

For all the waste schemes described, some criteria had to be used, whether formally or not, for the establishment of a list. Ideally, if

the criteria for hazardous wastes were defined first, then there would be no question whether a substance were hazardous--it would satisfy a criterion by passing a test. Thus, concentrations could be taken into consideration, rather than small amounts of a hazardous chemical constituent making a waste "hazardous," (as is implied by some definitions), although amounts of waste itself and circumstances are both relevant.

But these criteria tests bring up the problem of widespread sampling and analysis, which cannot only be expensive, but also taxing on laboratory capacity--especially on wastes which are of no value. Thus, the hazardous waste lists have evolved to eliminate some of these disadvantages.

The end result of the identification process has been a list of hazardous wastes, of some length, official or unofficial, for every country. The lists vary in detail from naming specific chemicals, to naming chemical compound groups, to identifying industry waste streams.

No one country uses only one level of detail in their listing. Some use an industry-specific or process-specific classification system as a cross index to a chemical group listing and/or a specific chemical list (California, USA; Netherlands). Others use the industry waste-stream classification with the intent of establishing a more specific list in the future. Other countries use a combination of two or three systems of defining waste in one list (France, Denmark, EEC).

Exhibit 3 has been prepared to illustrate those wastes which three (or more) and five (or more) participating countries have in common according to their current lists of hazardous or potentially hazardous wastes. An "X" signifies that the particular country actually has such a

waste category; a "P" signifies that a country's category is only a part of the category in the left column or that the waste is considered hazardous under certain restrictions. It is interesting to note that the majority of classes that five or more countries have in common are those defined on the chemical-compound-group level.

The current hazardous waste lists are generally in a developmental and/or unfinished stage of preparation. Denmark has supplied a final list of wastes, but no criteria for selection were available for comparison. The EEC, while providing a list of chemical compounds to define Toxic and Dangerous wastes, also gives no criteria for the selection of the wastes. The list is by no means exhaustive when compared to the California, (USA), the UK, or the FRG lists, although it may be an important step as a common base for initial hazardous waste identification by the member countries.

The list provided by the Federal Republic of Germany has been officially passed as a bylaw. Two distinct advantages of the enacted system are 1) that Lander may declare additional wastes depending on local conditions, and 2) the quantity of waste does not play a direct role in the classification criteria.

The French regulation (decree) that has been drafted to define hazardous wastes also lacks any accompanying criteria utilized to establish the list. While the list of specific chemicals from the Labor Code is very detailed and extensive, the industrial-waste classification provided by the decree is not as comprehensive as the other countries' lists.

The Netherlands has passed regulations in fulfillment of legislation, to establish an official hazardous waste list. While very general

criteria are given for the establishment of their classification (persistency, toxicity, bioaccumulation), specific concentration levels calculated on a dry weight basis are spelled out in the regulations: 50-5000-20,000-50,000 mg/kg. The chemical compound classification is quite extensive, but not as explicit as California's List, which leaves no doubt in the producer's mind exactly which chemicals of a compound group are to be considered hazardous. The cross classification by means of a "process" list in the Netherlands seems to be an advantageous method of classification, lest the waste producer be unsure of the constituents of his waste.

The United Kingdom's preliminary list has also been provided without accompanying criteria. The country has established industry-related waste classes and intends to establish a detailed list of chemicals to accompany the first class. Also published in part by the UK is a series of Waste Management Papers which each give a detailed description for the treatment and disposal of particular wastes.

The United States has not yet established regulations to accompany the recently passed Resource Conservation and Recovery Act. Within 18 months, the regulations defining hazardous waste (criteria and list) will be published.

California's present system was the only sample analyzed that explicitly stated several criteria for hazardous waste identification. From these specific criteria established in the legislation, equally specific classifications of hazardous chemicals have been published. The system's cross classification of process-specific wastes appears to

be a sure method for identifying hazardous wastes whose individual components may often vary. California's particular Generic List is brief, however, when compared to even the preliminary ones of the FRG or UK.

The fact that some countries have existing regulations for municipal or other non-hazardous waste disposal has a great deal to do with how far along they have come in developing lists of hazardous wastes. For example, in the United Kingdom a wide range of all wastes are "controlled" according to the Control of Pollution Act of 1974. Thus, the classification of "special wastes" can be a refinement of their total waste management system, such that the special wastes may be disposed in a safe manner.

The United States, on the other hand, is in the process of analyzing all solid waste, and at the same time preparing a hazardous waste classification scheme. Thus, Federal hazardous waste management regulation is just being introduced in a country where wastes were heretofore regulated by individual States.

Finally, the character of a country's classification system is not purely a function of the best technology available. Political and economic environments influence the technical considerations. For example, the extent to which industry or the public are accustomed and/or allowed to participate in the classification decisions can have a major impact on the final scheme.

In summary, there is not strict consensus as to the methodologies used to identify hazardous wastes due to the differing governmental decision-making processes. The results of the several methodologies when translated to lists do portray a number of similar concerns for several classes and types of wastes.

EXHIBIT 3A

WASTES CONSIDERED HAZARDOUS OR POTENTIALLY HAZARDOUS BY THREE OR MORE COUNTRIES

	Denmark	EEC[1]	Federal Republic of Germany	France[1]	Netherlands	United Kingdom	California, USA	
Aluminum-Containing Waste	X		X	P	P	X	P	
Antimony & Compounds		X		X	X	X	X	
Arsenic & Compounds		X	X	X	X	X	X	
Asbestos	X		X	X	X	X	X	
Beryllium Waste		X	X	X	X	P	X	
Cadmium Waste		X	X	X	X	X	X	
Chlorine				X	X		X	
Chromium III Waste	P			X	X		X	
Chromium VI Waste	P	X	X	X	X	X	X	
Copper Waste	X			X	X	X	X	
Cyanide Compounds	p	X*	X	X*	X	X	X	*excluding ferro- and ferri-cyanide
Dye Manufacturing Waste	X		X		P	X		
Florine				X	X		X	
Halogenated Solvents	X	P	X	X	X	X	X	
Herbicides	X	X	X	P	X	X	P	
Isocyanates	X	X		X	X	X		
Laboratory Waste		X		X	X			
Lead Waste	X	X	X	P	X	X	X	
Magnesium Waste			X	P	X	X	X	
Mercury Waste	X	X	X	X	X	X	X	
Metal Surface Treatment Waste	X	X	X	X	P	X	X	
Nickel Waste	X			P	X	X	X	

EXHIBIT 3A, CONTINUED

WASTES CONSIDERED HAZARDOUS OR POTENTIALLY HAZARDOUS BY THREE OR MORE COUNTRIES

	Denmark	EEC[1]	Federal Republic of Germany	France[1]	Netherlands	United Kingdom	California, USA
Non-Halogenated Solvents	X	P	X	P	X	X	X
Oil Refinery Waste	X		X	X	X	X	X
Organic Peroxides	X			P	X	X	
Paint Manufacturing Waste	X		X	X	P	X	X
Pesticides	X	X	X	P	X	X	X
Pharmaceutical Manufacuring Waste		X	X	X	X	X	
Phenol-Containing Waste	X	X	X	X	X	X	P
Phytopharmaceutical Waste		X		X	X	X	
PCBs	X		X	X	X	X	X
Rubber Manufacturing Waste	X		X	P		X	
Silver-Containing Waste	X				X	X	X
Sulfur-Containing Waste	X		X	P	X	X	X
Thallium Waste		X		X	X		X
Vanadium & Compounds				X	X	X	P
White Phosphorous				X	X		X
Zinc Waste	X			X	X	X	X

1 Draft List
2 "P" indicates that a country's category falls partially under the heading in the left column, or that the waste is considered hazardous under certain restrictions.

EXHIBIT 3B

WASTES CONSIDERED HAZARDOUS OR POTENTIALLY HAZARDOUS BY FIVE OR MORE COUNTRIES

	Denmark	EEC[1]	Federal Republic of Germany	France[1]	Netherlands	United Kingdom	California, USA	
Aluminum-Containing Waste	X		X	P	X	X	P	
Antimony & Compounds		X		X	X	X	X	
Arsenic & Compounds		X	X	X	X	X	X	
Asbestos	X		X	X	X	X	X	
Beryllium Waste		X	X	X	X	P	X	
Cadmium Waste		X	X	X	X	X	X	
Chromium VI Waste	P	X	X	X	X	X	X	
Copper Waste	X			X	X	X	X	
Cyanide Compounds	P	X*	X	X*	X	X	X	*excluding ferro- and ferri-cyanide
Halogenated Solvents	X	P	X	X	X	X	X	
Herbicides	X	X	X	P	X	X	P	
Isocyanates	X	X		X	X	X		
Lead Waste	X	X	X	P	X	X	X	
Mercury Waste	X	X	X	X	X	X	X	
Metal Surface Treatment Waste	X	X	X	X	X	X	X	
Nickel Waste	X			P	X	X	X	
Non-Halogenated Solvents	X	P	X	P	X	X	X	
Oil Refinery Waste	X		X	X	X	X	X	
Paint Manufacturing Waste	X		X	X	P	X	X	
PCBs	X		X	X	X	X	X	
Pesticides	X	X	X	P	X	X	X	
Phenol-Containing Waste	X	X	X	X	X	X	P	

EXHIBIT 3B, CONTINUED

WASTES CONSIDERED HAZARDOUS OR POTENTIALLY HAZARDOUS BY FIVE OR MORE COUNTRIES

	Denmark	EEC[1]	Federal Republic of Germany	France[1]	Netherlands	United Kingdom	California, USA	
Sulfur-Containing Waste	X		X	P	X	X	X	
Zinc Waste	X			X	X	X	X	

[1]Draft List

[2]"P" indicates that a country's category falls partially under the heading in the left column, or that the waste is considered hazardous under certain restrictions.

III. Waste Sampling and Analysis

Waste Sampling

The cornerstone of any viable waste management system is the procedures used to retrieve those samples analyzed to determine how the waste should be managed. Unless the sample taken is representative of the waste material as an aggregate, the information extracted from the sample is misleading. The need for standardized sampling procedures is obvious. Unfortunately, most discussions of waste sampling discuss the problems involved in a general manner and do not give specifics on how to deal with these problems, or descriptions of particular sampling procedures.

The following is an outline of how the problem of waste sampling has been addressed by various organizations:

Federal Republic of Germany

In the Federal Republic of Germany, no standard waste sampling techniques have yet been proposed; however, a working group of the FRG and the Lander actually is in the process of developing such guidelines. A Working Group on Analytical Procedures for Sludge and Solid Waste within the Society of German Chemists has published a paragraph on waste sampling, but this only discusses the problems involved in obtaining a representative sample and gives no procedures.

The Federal Republic of Germany's contribution to the Pilot Study, however, stresses the following points in Appendix 1.1 (sampling):

a. The heterogeneous composition of waste dictates that all phases must be sampled (i.e., a complete vertical sample of fluid portions as well as solid residue and vapor phase must be taken).

b. Waste production may vary as to the time or length of operation (i.e., effluent off the initial stages of a process may differ from effluent off later stages). The sample taken must be representative of all the effluent.

c. When withdrawing aliquots for analysis from samples, the aliquots must also be representative of the aggregate waste. This may require mixing of the sample before withdrawing the aliquot.

d. Sample preservation methods should mimic the ambient conditions of the wastes' "natural" environment (e.g., anaerobic sludge samples should be protected from air, etc.).

e. Sample fixation may be necessary for wastes containing volatile or unstable components.

United States

The United States has no officially recognized standard methods of waste sampling. Several groups such as U.S. EPA, and the ASTM (American Society for Testing Materials) are considering the problem.

There are methods presently being employed, however, for sampling waste products and also for sampling materials with consistencies similar to waste products, which can be adapted for use in waste sampling. These methods are primarily of two kinds: those that can be used for fluids and those that can be used for granular non-fluid type materials. Examples of the former include the California Department of Health's Coliwasa sampler and the oil thief (for non viscous fluids) (see ASTM standard, D270-23). Examples of the latter include soil augers (see ASTM standard D1452-19) and grain sampling triers.

Discussion

There seem to be no validated, standardized step-by-step waste sampling protocols presently in use in any of the member nations. Several organizations are presently working on developing such protocols. It is unlikely that a single waste sampling protocol will emerge from these concurrent efforts, since different waste types may well require different procedures. At this point, it is apparent that the methods evolved will contain the following elements:

1. A method of obtaining either a continuous vertical sample or many different point samples on the vertical axis.

2. Specifications as to when a stream is to be tested (i.e., beginning of process, after process, randomly, etc.).

3. Separate procedures for different physical characterizations of the waste (and possibly a procedure for determining that characterization or state).

4. Methods of sample preservation.

5. Protocol to avoid cross contamination by residues left in the sampler.

Waste Analysis

The analysis of waste materials is complicated by the following factors. The composition of waste constituents often ranges over a wide variety of chemical types and over many orders of magnitude of concentration.

The presence of other constituents in a sample under analysis can introduce interference, since wastes often contain many of these other constituents. It is very difficult to compensate for their presence in the interpretation of the analytical data. Also, most wastes are not in a physical form or state that is amenable to analysis. For a standard analytical methodology to be prescribed, the wastes must be in some sort of "standard state." For this reason, significant amounts of pretreatment are often required before analysis can begin. The following is a discussion of how various organizations are addressing the problem of waste analysis.

Federal Republic of Germany

The handbook on "German Standard Procedures for Analysis of Water, Effluent and Sludge" (DEV), edited by the Working Group 'Water Chemistry' within the Society of German Chemists contains a chapter entitled: "Analysis of Sludge and Solid Waste." A short summary of those sections pertinent to waste analysis is presented here:

a. Determination of Water Content and Dry Residues:

This is a procedure for preparing a dry residue of the waste by evaporation (including the removal of most water of crystallization from wastes with high inorganic content).

b. Determination of Loss on Ignition of Dry Residue

The method described is a measure of organic content. The method is an ashing procedure (run at 550°C) and has some interference from water of crystallization, magnesium carbonate releasing carbon dioxide, and organics which volatilize slowly at this temperature.

c. Determination of Hydrogen Ion Concentration (pH Value)

The method described employs a pH meter, and describes sample preparation and handling as well as meter calibration, and possible interferences (i.e., fats and oils). It is recommended in this treatment that the test be run as soon after sampling as possible to prevent gas exchange (pH can, to a large extent, be a function of carbon dioxide concentration).

Not yet contained in the DEV are standard analytical procedures for free cyanide or total mercury. These are available in preprint and are summarized as follows:

a. Determination of total cyanides

Detection by the German Standard Method (DEV), D13, Part 1 (total cyanides) $\frac{\text{th}}{7}$ Serial, Verlog Chemie GmbH, Weinheim/ Bergstor)

This method detects most CN groups including metal cyanides, and various cyanocomplexes, s.a. with iron. (The cobaltcyanide complex is only partly decomposed by the method and, therefore, not totally detected). The method is applicable for cyanide concentrations up to 100 mg/l. Both a volumetric and a photometric method is described herein. The photometric is more sensitive, but also is more susceptible to interference from reducing agents.

A rapid, field test method for cyanide analysis in waste water is described by J. Bortlisz (Haus der Technik - Vortragsveroffentlichung No. 283). This method can be used in samples containing from 1 to 100 mg/l easily liberated cyanides. By this method, hydrogen cyanide is liberated by

mixing the waste with acidic solution. Detection is by visual colorimetric means. The liberated HCN is seen in a standardized test tube ($HgCl_2$/methyl red). Interference is caused by free chlorine; this, however, can be overcome by using a reducing agent such as sodium arsenite beforehand.

The 'Analytical Chemistry' Working Group of the Caucus on Waste Disposal of the Lander (LAGA) has proposed analytical techniques for the determination of cyanides in water samples, and it is working on techniques for the determination of heavy metals in solid wastes.

b. Detection of Mercury

In order to determine mercury content, organically bound mercury must be transformed into inorganic mercury. In this procedure, intense UV radiation in an acidic, oxidizing medium, is used to accomplish this transformation. This method is suitable for all types of waste waters, and for mercury concentrations from .05 to 10 g/l. The method of detection is atomic absorption, utilizing a hollow cathode lamp as a radiation source.

Another important aspect of waste sample pretreatment is elutriation of the waste and then analysis of the elutriate for various chemical species. The "leaching" of a waste by the various waters with which it comes into contact is one of the primary vectors of pollution from land disposal. Therefore, this type of waste sample pretreatment is

very appealing, since the elutriation process can be thought of as a leaching process. Some leaching or elutriation tests attempt to mimic natural leaching processes, while others simply attempt to indicate whether there is a "potential" for leaching for a particular waste and do not attempt to recreate in the elutriation solvent physical parameters identical to the natural leachate.

Federal Republic of Germany

The FRG has such a pretreatment procedure. It does not attempt to reproduce the exact parameters of natural leachate, but only serves to determine if various chemical species may dissolve when the waste is in contact with water.

The following is a general outline of the procedure. The waste is separated into a liquid and solid phase by centrifugation or filtration. The filter residue (or solid phase) is mixed in a 1:10 ratio with distilled water and vigorously shaken or stirred for 24 hours. As the agitation is proceeding, electrical conductivity measurements may be taken to determine if solubility equilibrium has been reached. This mixture is then filtered and standard water analysis methods are used on both the original liquid filtered off and the filtrate from the elutriation process.

Also, performance of multiple elutriations may be desirable both to simulate natural processes and to distinguish between the following situations:

a. Wastes containing contaminant species with such a high solubility or which occur in such minute quantities that they are leached quantitatively in the course of the initial elutriation.

b. Wastes containing species with such low solubility, or are in such a large quantity that they become dissolved only partially in the initial dilution.

c. Wastes with contaminants which show changes in behavior, as they come into contact with the leachate.

It is important to distinguish between these various waste types for operational management purposes. The technique of multiple elutriation involves repetitive dehydration and filtration followed by elutriation with fresh solvent. Each resultant elutriate is analyzed separately.

Finally, the solubility of contaminants in a waste under conditions of various pH's may be of interest. Wastes may come into contact with waters of pH's other than neutrality due to dissolved CO_2, actions of other wastes, biological by-products of waste degradation, etc. Depending on the interest of the experimenter, the elutriate test may be run using .1N hydrochloric acid, .1N sodium hydroxide, or water saturated with carbon dioxide substituted for distilled water.

Canada

In April 1975, the Solic Waste Mangement Branch, Environmental Protection Service, Environment Canada, and the Department of Civil Engineering, University of British Columbia, co-sponsored an international round table seminar on landfill leachate analysis. The appended Seminar Proceeding Report, "Procedures for the Analysis of Landfill Leachate," EPS-3-SW-75-9, contains recommendations on analytical techniques which are appropriate for leachate characterization and analysis. The methods of choice for the analysis of most chemical contaminants in leachate-type medium are those contained in "Standard Methods for the Examination

of Water and Waste Water," 13th Edition, 1971, APWA, AWWA, APCF, American Public Health, N.Y., and the U.S. EPA Manual entitled "Manual of Methods for Chemical Analysis of Water and Wastes," U.S. Environmental Protection Agency, Office of Technology Transfer, Washington, D.C., EPA-625-1-6-74-003. The seminar proceedings, also, however, mention modifications to the techniques recommended by these references that they have found helpful, problems and interferences the seminar participants have run into in using these methods, useful pretreatment techniques, as well as other techniques not referenced by these two manuals, which the participants have used with success.

United Kingdom

There are no mandatory standard analytical procedures in the United Kingdom, nor are there likely to be. It is the sentiment there that formulating such standards is not what is needed, due to the difficulties of specifying these standards and ensuring enforcement; rather, an open dialogue of the various problems attendant to waste analysis should be encouraged. Furthermore, many of the methods recommended by the United Kingdom's Department of the Environment for water analysis should also be applicable to waste analysis, and organizations such as the Society for Analytical Chemistry have collected recommended methods for analyzing materials such as trade effluents. Preliminary work is now being undertaken for the Department of the Environment with a view to commencing a research project on the leaching of wastes.

United States

The United States Environmental Protection Agency does have recommended procedures for waste analysis; these are contained in the aforementioned "Manual of Methods for Chemical Analysis of Water and

Wastes." It is recognized that these methods are not applicable to the analysis of all waste streams and much research is presently being done by the Agency on analytical methods for wastes.

There is at present no official Federal elutriation method for wastes. The State of Texas, however, has recommended the following elutriate test, promulgated by the State Water Quality Board.

Solid Waste Evaluation Leachate Test

1. A 250 g representative sample of the "dry" material should be taken according to AOAC or ASTM Standard methods and placed in a 1500 ml Erlenmeyer flask.

2. One liter of deionized or distilled water should be added to the flask and the material stirred mechanically at a low speed for five minutes.

3. Stopper the flask and allow to stand for seven days.

4. Filter the supernatant solution through a 45 Micron glass filter.

5. The filtered leachate from (2) should be subjected to a quantitative analysis for those component or ionic species determined to be present in the analysis of the waste itself.

Note: Triplicate samples of the waste should be leached in order to obtain a representative leachate.

The U.S. Environmental Protection Agency is presently doing research on the development of a Standard Elutriate (Leachate) Test, as are other organizations such as ASTM (American Society for Testing Materials) and API (American Petroleum 'nstitute).

U.S.EPA has recently published a manual entitled "Compilation of Methodology Used for Measuring Pollution Parameters of Sanitary Landfill Leachate," EPA-600-/-3-75-011. This work describes methods presently being used by researchers for leachate analysis, and contains information on interference and other problems which arise in leachate analysis and how to approach these difficulties.

Discussion

The problem of waste analysis is far from solved. The large number of potential constituents, their differing properties, the wide range of concentrations they may be present in, as well as the many different matrix effects, make the problem of developing standard methods exceedingly complex. There are useable inexpensive techniques for most inorganics of concern, especially heavy metals; the interferences involved in these techniques are understood to an extent, and pretreatment can often overcome these difficulties. Extensive separation is often required before analysis, and the interpretation of the analytical data is often ambiguous. Unless the analyst has some fairly good idea as to what organics are present in the waste, presently available methods are too expensive and time consuming to be of use in routine waste analysis.

Elutriate tests presently being used are not comparable to natural leaching action. Natural leachate solubilizes waste components because of many physical parameters of the leachate including pH, dielectric

constant, organic content (which can act as chelating agents, buffering agents etc.), temperature, redox potential, and others. It is impossible to address all these parameters in all their potential ambient ranges, in any one standard leaching process. Therefore, much work needs to be done in this area. Also, standard filtration and centrifugation methods must be developed. Leachate analysis can suffer from different interferences and matrix effects (due to high organic content, turbidity, etc.) than those of waste water and waste analysis. Therefore, it is necessary that standard methods for the analysis of leachate and the filtrate from leaching tests be developed.

It is clear that work has already been done on sampling and analysis of waste itself and also in connection with waste disposal in landfills (e.g., leachate analysis). Further work has also been done in some countries in connection with other disposal methods, e.g., incineration, in the form of standard incineration tests and sampling and analysis of slag, fly ash, and flue gas. However, due to the lack of information on these methods at present, these considerations were not covered in this report.

IV. Site Selection

Since human health and environmental protection are major concerns in the disposal of hazardous wastes, careful site selection for safe disposal of these wastes is one of the most important first steps for controlling the long-term effects of the hazardous properties of the discarded materials.

The purpose of this chapter is to present the approaches of several countries (FRG, UK, USA) to the problem of identifying site selection criteria. These criteria primarily apply to land disposal facilities; different criteria may apply to other types of hazardous wastes in other facilities. The objective is to discuss the descriptive criteria or parameters suggested in the various schemes rather than the specific technical levels specified by each approach.

Federal Republic of Germany

As required by the Federal Act on the Disposal of Wastes of June 7, 1972, individual Waste Management Plans are implemented on the Lander (State) level, rather than one plan on a national level. "Special Waste Companies" have been created by some State authorities that have been given responsibility for construction and operation of special disposal facilities; naturally the resulting plans established by various Lander are different in character. The plan of the State of Baden-Wurttemburg has been chosen for discussion purposes as an example of German site selection criteria.

This plan consists of an evaluation procedure to grade 1,000 potential sites in the State. The procedure evaluates a very extensive list of site parameters which are grouped in a matrix according to subject area. Each area consists of several very specific site parameters.

The major subject areas evaluated with regard to both treatment and disposal facilities are:

- size of the site
- possibility of expansion
- ability of obtaining the site (ownership, state of development of land)
- proximity to subsurface structures
- proximity to similar facilities
- changes in surface and subsurface structures as a result in the landfill
- influences occuring during the life of the landfill
- influences of the landfill after shutdown
- site characteristics with respect to water management
- possibilities of percolation water and process water drainage
- dispersion climatology
- background level of air pollution
- natural capacity of the site to abate emissions from landfill operations
- availability of earthen materials
- degree of difficulty of earthenwork engineering
- site conditions that could cause hazards
- possibilities of landfill site regarding long-term maintenance

Each site parameter is assigned a weighting factor to assess its importance in the overall site selection process. The weighted values are totalled to determine a site's overall score, the higher scores reflecting a more desirable set of site conditions. It is recognized that a major deficiency in an important parameter may not be adequately reflected in the final score if the assigned rating for that parameter is not critical enough. Therefore, minimum requirements are recommended for each of several criteria that are critical to the evaluation process--those concerned with surface water and groundwater movement.

The United Kingdom

The British have adopted a classification scheme for their disposal sites such that a wide range of wastes may be assigned to a particular site depending on their quantity, solubility, toxicity, concentration, etc. A potential site is first evaluated for its ability to attenuate leachate, i.e., the geology and soils are studied. From this data, the site is classified as one of three groups:

- Those providing a significant element of containment for wastes and leachates.
- Those allowing slow leachate migration and significant attenuation.
- Those allowing rapid leachate migration and significant attenuation.

Other aspects are considered as well in this initial screening such as location and size of site, visual and other amenity factors, access and transport, land use, and long-term controls which are thought to be necessary.

Once the potential landfill site has been selected and classified into a broad group, hydrological, hydrogeological, and further geological data may be collected to evaluate the site's ability to accept certain types of waste. Some or all of the following parameters are used to provide this more detailed information:

- Depth to water table
- Water table contour maps for different seasons of the year
- Location and distance to points of water use
- Ratio of evapotranspiration to precipitation minus runoff (estimate of leachate volume)
- Stratigraphic and structural data to base of shallowest confined aquifer, including data on old mineral workings
- Base-flow data on nearby perennial streams
- Chemistry of water in aquifers, confining beds, and probable leachate composition.

Additionally, for sites that may receive large quantities of hazardous wastes, the following information may be required:

- Laboratory measurements of permeabilities, effective porosities and ion exchange capacities of each lithology in the unsaturated and saturated zones
- Measurements of moisture content and in situ soil moisture tension in the unsaturated zone

- Three-dimensional distribution of head to base of shallowest confining aquifer
- Field tests to determine storage coefficients and transmissivities
- Definition of recharge and discharge areas for unconfined and shallowest aquifer
- Field measurements of dispersivity

All of the criteria discussed herein have been provided as guidelines to local authorities for site selection by the Institute of the Geological Sciences in the Department of the Environment's Waste Management Paper No. 4. The United Kingdom's site selection system, then, is based on recommended field measurements which can be weighted judgementally by professional engineers and scientists to determine a site's suitability for certain types of waste, subject to appropriate planning and also site licensing conditions.

The United States of America

A national site selection process has not been established. The U.S. Environmental Protection Agency (EPA) has drafted a preliminary guidance document on Hazardous Waste Landfill Site Screening Criteria. Several States have adopted their own plans as well; the site selection criteria for the State of California and the preliminary Illinois EPA landfill classification system will be discussed here.

EPA views site selection as a phased decision process. The first phase, site screening, is used to establish a minimum set of criteria which must be met in order for the prospective site to be considered as a candidate for further investigation.

Site screening is defined as the process of identifying and evaluating a parcel of land as suitable for use as a hazardous or chemical waste land disposal site. Site screening criteria constitute the set of mandatory properties or parameters, which, in total, typify an acceptable landfill site. A single site screening criterion is a suggested level of environmental protection that a site parameter must possess or achieve either as a natural condition or as a result of site modification, such that it can be judged by a simple "go/no go" decision.

EPA supports a "decision tree" as a useful tool for evaluation of site screening criteria. The tree is a flow chart of "yes-no" decision points, where the desirable quality of an individual site parameter is stated at each decision point. In total, the "tree" constitutes a minimal set of envirionmental parameters important to maintaining the environmental quality of a given site. A naturally secure disposal site would be any site whose set of environmental conditions satisfied the initial criterion stated at each decision point. A comprehensive decision

tree could also provide a recommended means of modifying an unsatisfactory site parameter to satisfy the criteria and provide a variance procedure which the applicant could use.

Some of the screening criteria established by the document include fault area, floodplain area, groundwater suitability, precipitation, storm runoff, erosivity, perched water table, and excess water. In decision-tree format, a sample question would be, "Is the area beneath the site free of geologic faults?" If not, the site would be further considered by additional criteria, until accepted or rejected as being suitable for hazardous waste disposal.

Another major factor which must ultimately be considered in the total site selection process is economics, as site modification costs may be extensive for a site to be acceptable. In addition to costs for site modification to meet the screening criteria, there may also be costs involved in the reconciliation of some of the factors identified in the second phase of site-selection--evaluation or "trade-off" analysis of additional factors. Once minimum acceptable site criteria are met, economics may be the only factor of concern to the permit applicant in the trade-off analysis; on the other hand, the environmentalist or the permit granting authority may want to accomplish the maximum level of protection, regardless of cost.

In addition to the "value" that can be associated with exceeding the minimum site screening criteria, some of the other, more local factors to be considered in the total site selection process include site access and impacts on land use, aesthetics, ecosystems, and historical features. For example, desirable access parameters would minimize transportation costs as well as the risk of accident or property damage.

Distance from the waste source, congestion, and route suitability for bulk cargo vehicles are several of the primary factors which affect site accessibility.

EPA, then, proposes a decision-tree type of site selection process to consider the hydrogeologic data of the proposed site. This evaluation is followed by an environmental impact statement which accounts for economics and local, less-measurable environmental conditions in the final decision.

California

The State of California defines a Class I disposal site as a site at which complete protection is provided for all time for the quality of ground and surface waters from all wastes deposited therein and against hazard to public health and wildlife resources. The following desirable characteristics are specified as prerequisities for a Class I site:

- Geological conditions must be naturally capable of preventing hydraulic continuity between liquids and gases emanating from the waste in the site and usable surface or ground waters.
- Geological conditions that are not naturally capable of preventing lateral hydraulic continuity between liquids and gases emanating from wastes in the site and usable surface or ground waters, or the disposal area, must be modified to achieve such capability.
- Underlying geological formations which contain rock fractures or fissures of questionable permeability must be permanently sealed to provide a competent barrier to the movement of liquids or gases from the disposal site.

- Inundation of disposal areas shall not occur until the site is closed in accordance with requirements or the regional board.
- Disposal areas shall not be subject to washout.
- Leachate and subsurface flow into the disposal area shall be contained within the site unless other disposition is made in accordance with requirements of the regional board.
- Sites shall not be located over zones of active faulting or where other forms of geological change would impair the competence of natural features or artificial barriers which prevent continuity with usage waters.
- Sites made suitable for use by man-made physical barriers shall not be located where improper operation or maintenance of such structures could permit the waste, leachate, or gases to contact usable ground or surface water.
- Sites which comply with the above requirements but would be subject to inundation by a tide or a flood of greater than 100-year frequency may be considered by the regional board as a limited Class I disposal site.

It is worthy to note that some criteria are worded in the negative and define conditions that are not acceptable as opposed to enumerating site conditions that are desirable.

The State Water Resources Control Board has defined several desirable hydrogeological features of a Class I site in their disposal site design guidance issued in March of 1975. Several design objectives related to surface runoff and flooding are proposed and supported with explanations. Acceptable impermeable conditions are defined as:

- Fine grain soils classified as CL, CH, or OH by the United Soil Classification System
- Permeability 10^{-8} cm/sec or less is considered to be impermeable
- Not less than 30 percent (by weight) of the soil passing through a number 200 sieve
- A liquid limit of not less than 30 as determined by ASTM test D423
- Plasticity index of not less than 15 as determined by ASTM test D423

Illinois

The Illinois EPA has developed a set of criteria for the location and design of their Class I and Class II landfills, which, of the five groups of landfills classified by the state, would be acceptable to contain hazardous wastes. The criteria used to evaluate the suitability of the landfills to accept hazardous wastes are as follows:

- Prevention of surface water entering landfill; any runoff from landfill must be properly treated before discharged
- Trench method of disposal

- Waste confinement (liner)
- High ion exchange capacity, preferred
- Depth to permeable bedrock--minimum of 10 feet (3 meters)
- Groundwater monitoring facilities required
- Minimum of 300 feet (91.5 meters) between edge of trench and surface water body
- Site must be above 100 year floodline
- Landslide and active faults--one mile minimum from active faults; landslide area unacceptable
- Trenches must be composed of in situ natural earth materials
- Hazardous liquid wastes must be containerized

Although the criteria are somewhat generalized, they can be adapted to different parts of the country having similar geology and climate.

Discussion

In analyzing the contributions for site selection, there appear to be three basic approaches to such a process. First, the analytical matrix prescribed by the State of Baden-Wurttemberg (FRG) attempts to quantify qualitative parameters (as well as the physical, measurable ones) such that all site selection factors play a weighted role in the total decision process. Second, the United Kingdom's criteria list, California's system for selection, and the selection plan for Illinois, all represent schemes that depend on the considered selection of criteria of concern, and the judgemental interpretation of hydrogelogical and other technical, social, and economic data that are gathered. Third, the EPA guidance document represents a middle ground between the matrix and the criteria checklists. Once a site has been chosen by means of a "decision tree" on the basis of meeting acceptable physical parameters,

an additional analysis is made through an environmental impact statement. In this statement other factors such as ecological, social, and political values are seen as viable trade-offs with the physical acceptability of the site.

One problem with using either the criteria checklist or the matrix as a decision tool is that an attempt is made to trade-off all parameters, whether physical or other, at one time. The decision tree, however, presents a structured approach that forces step-by-step "yes-no" decisions to be made to establish a physically acceptable site. Then, an environmental impact statement determines the importance of economic and other factors in the total selection process.

Of the first two methods mentioned, though, the matrix has an advantage in that a reader knows the value assigned to a parameter in the total decision, whereas using a checklist, the assigned weight is not known; professional engineering judgement is used to weight the factors. But the problem of uniform application of weighting scales plagues the matrix method; i.e., the evaluators' opinions will not be consistent.

Exhibit 4 compares site selection criteria for Baden-Wurttemberg (FRG) the United Kingdom, California, Illinois, and the U.S. EPA. An "X" signifies that a particular criterion has been declared to be a site selection factor by a party; a "P" indicates a partial identification of that factor by one of the systems. Fourteen of the 88 criteria have been identified by three or more parties as being of concern. They are listed in Exhibit 5 . As might be expected, it is the hydrogeological factors which are of most common concern. Consequently, close collaboration with geological experts is desirable on this matter.

In summary, all countries that have formalized site selection have found it necessary to use some type of systematic plan to choose their sites. The State of Baden-Wurttemberg (FRG) has developed a detailed matrix where all selection criteria, whether quantifiable or not, are assigned weighted values such that they all are considered as part of the total decision. Other site selection systems such as California, Illinois, and the United Kingdom judge from field and other data whether a site is acceptable or not. EPA has proposed a decision tree whereby a site is screened for physical acceptability; and environmental impact statement then is used to analyze other less tangible factors which might influence the selection of a site. Although these systems differ in their site evaluation methods, they do have in common certain site selection factors which include measurable soil and groundwater conditions.

Citizen Acceptance

An integral part of the site selection process is acceptance by the community of the plan for a hazardous waste management facility. As such, a well-informed public is of major concern to the responsible authorities so that the citizen may be well aware of all aspects of the proposed facility. The degree of consideration of this input to the selection process naturally varies because of the nature of different governments; the policies of France and the United States are two that are discussed below.

France

The Ministry of the Quality of Life has conducted a study concerning ways of involving the public in the decision-making process concerning a household waste treatment center ("Ordures Menageres: L'Implantation d'un Centre de Traitement," Paris, March 1976).

The "public" is segmented as the local elected officials, committees of residents, and environmental interest organizations that the government feels it must plan to influence in order to gain acceptance of a household waste treatment center.

The strategy as outlined in the study, the strategy for impacting these groups, specifically aims at 1) taking into account the attitudes and opinions of the "principal actors" (local elected officials, resident and environmental organizations); 2) obtaining the approval of these actors for the options selected by those responsible for the project; and 3) reducing the phenomena of resistance and opposition that might appear before, during, or after the beginning of the project. Thus, the strategy of introduction of a treatment center should be developed prior to the introduction of the center in the form of instruction, information,

consultation and planning; and during and after the introduction of the treatment center in the form of information and appeasement in the case of resistance or opposition.

The actions to be taken to educate the public relate to the site selection phases outlined in this document (phases O,A,B,C,D,E, and F). They include the following. In phase O, the "Establishment of a Study and Decision-Making Committee," the objective is to allow the local elected officials to take charge of the problem and proceed to study a solution in an orderly manner. This information should be distributed via the press.

In Phase A--"The Study of Wastes"--the objective designated in the plan is to make the public aware of the necessity of finding new means for treating the community's household wastes over time, and to stress the dependence of the solutions to waste treatment on the communities involved. It will be necessary to provide the public with information on current waste disposal systems versus results of the study of a proposed waste disposal system (technical data should be presented). Finally, the argument for the new system should be presented. Again, the local press is recommended as the most effective means of communication.

The objective of public information in Phase B--"Study of Procedures"--is similar to Phase A. The point is to show the procedural differences in existing versus proposed facilities and their advantages and disadvantages.

Information on Phase C--"Study on Sites"--is not recommended to be disseminated, as release of such data may unduly arouse the population at a premature stage and create many resident opposition committees at an early stage.

Phase D--"Elaboration of a Group of Variations"--is essentially a selection tool that reduces the number of sites from which to choose, and as such is seen as a "relatively functional" phase that needs no explanation to the public.

The objective to inform the public of Phase E--"Detailed Studies of Variations and Analysis of the Variations"--is to destroy any prejudices and a priori conceptions of the local elected officals relating to the treatment of household wastes. The concern here is to avoid the possibility that certain particularly favorable solutions might be eliminated too rapidly because of opposition from the local elected officials.

The final selection phase (Phase F)--"The Comparison of Variations and Choice of One"--should inform the population of the community treatment center with all of the information available on this center, immediately after the decision has been reached. By means of a public meeting, the following information should be supplied: 1) a technical description of the center; 2) data on its operators; 3) information on problems and disturbances; 4) information on resources it will provide to the community; 5) information on its cost to the community and to the residents; and 6) reasons for the choice, including technical reasons. It is hoped that with this final phase, the community members feel that all information has been disclosed to them, and that they fully understand the choice that has been made.

Although this detailed selection plan has been outlined for a municipal waste treatment center, the process of educating citizens of a hazardous waste treatment center might well be based on this plan. The level of acceptability of the two, by a community, cannot be equated, however.

United States

In recent years, governmental and private enterprise have been frustrated in their efforts to establish hazardous waste management treatment facilities in many States, due to community pressure against such development. The most common reaction of a community to a proposed site is complete disapproval, stemming from fears of contamination of groundwater and damage to human life and wildlife. These fears arise when campaigns, largely based on misinformation, are conducted against hazardous waste disposal sites. On the other hand, a public awareness program is believed to be capable of encouraging acceptance of well-regulated, well-controlled disposal facilities.

Specifically, a public education campaign should begin several months prior to announcing the site for the proposed hazardous waste facility, and it should continue after the facility is operating. Support from State, regional, and local government agencies and community organizations should be elicited. For example, local officials and citizens groups should be fully briefed about the details of the proposed site. To convey the message that properly managed hazardous waste sites do not present a substantial hazard to the public, the schools, media, and local industries should also be contacted. Prospective operators of the hazardous waste facility should participate in this program of public education. The public must come to believe in the honesty, thoroughness, and competence of the potential operator.

Specific educational tactics might include a door-to-door canvassing of neighbors adjacent to the proposed site, a speakers' bureau, and holding of public hearings. The effort to educate the public should emphasize the vital need for adequate disposal sites to prevent public

health and environmental problems. The educational campaign should also anticipate objections to the project. Clear, concise answers should be given to questions relating to odor, visible emissions, corrosion, fires, human health effects, and traffic. The distinction between a dump and a well-run waste facility should be clearly made. The latter can provide safe handling of waste materials, and it need not adversely affect local property values.

Responsibility for the public education program should rest with one person. This person (a local official, industry employee) would coordinate all efforts of this campaign. The coordinator would assure that due notice is given to the community, local officials, and other interested parties prior to public hearings. Detailed data, leachate controls, and emergency plans should be presented at these hearings. The education coordinator might exercise the prerogative of changing the "hazardous waste disposal site" to a less intimidating "chemical (or industrial) waste containment site." The coordinator should keep in mind, however, that public education does not guarantee public acceptance of the proposed facility.

In the event that a site for hazardous waste facilities is approved, promotion of good community relations should continue after facility operations have begun, as mentioned earlier. One hazardous waste management company holds a quarterly seminar with local officials and members of the community about topics of mutual concern. Additionally, tours of the facility are offered to the public by the company. This practice should be emulated by other hazardous waste facility operators. A facility progress report might be distributed to the community, as another means to promote continued good relations.

No prescription outlining a specific educational program and assuring community acceptance of a proposed hazardous waste treatment-disposal site will become available. The only firm conclusion that can be drawn from past experience is that the public should become intimately involved in the site selection process (after an initial screening of sites to those that satisfy technical criteria). State and local officials and industry representatives must be open and straightforward in their presentation of the proposed site to the community. An advisory committee, operating in conjunction with a State-wide hazardous waste management plan, can serve to ease community fears of having arbitrarily selected a location for a hazardous waste management facility. Despite these efforts at involving and educating the community about the proposed facility, local interests might have to rely on the State--through assistance in obtaining Federal land, through purchase and subsequent leasing of the sites, or ultimately through its condemnation powers--to obtain land for proposed hazardous waste management facilities.

Discussion

From the two countries' contributions received, it is obvious that citizen acceptance is a most important factor in site selection--one that is impossible to quantify, but that cannot be overlooked. The community disposition towards a facility can make the difference in whether or not it is a success.

EXHIBIT 4

SITE SELECTION CRITERIA IDENTIFIED BY CONTRIBUTING COUNTRIES

	FRG - Baden Wurttemberg	United Kingdom*	USA - California	USA - Illinois	USA - EPA Guidance			
Effective Landfill Area	X							
Landfill Volume	X							
Possibility of Expansion - Surface Area	X							
Possibility of Expansion - Volume	X							
Proprietorship Relations	X							
Readiness to Sell Property	X							
State of Development	X							
Proximity to Residental Areas	X							
Proximity to Natural Parks and Protected Landscapes	X							
Proximity to Recreational Areas	X							
Proximity to Special Farm Cultures	X							
Proximity to Sensitive Industrial and Trade Facilities	X							
Proximity to Industrial and Trade Areas of Similar Nature	X				P			
Proximity to Public Roads	X				X			
Proximity to Railroad Lines	X				P			
Proximity to Defense Facilities	X				P			
Effect on Drinking and Industrial Water Supply	X	X		X	X			
Effect on Wastewater and Percolating Water Drainage	X	X		X	X			
Effect on Surface Water Drainage	X	x		x	x			

EXHIBIT 4

SITE SELECTION CRITERIA IDENTIFIED BY CONTRIBUTING COUNTRIES

	FRG - Baden Wurttemberg	United Kingdom*	USA - California	USA - Illinois	USA - EPA Guidance			
Effect on Electricity Supply	X							
Effect on Estimate of Phone Connection	X							
Effect on Widening and Improving of Public Roads	X							
Effect on Land Improvements to Make Site Accessible	X							
Effect on Estimate of Railroad Connection	X							
During Life of Landfill:								
Influence on Landscape	X				P			
Influence on Destruction of Surface Relief	X				P			
Disturbances in Biotopes of Animals and Plants	X				X			
Interference With Historical and Folklore Elements	X				X			
Optical and Aesthetic Impairments	X				X			
After Shutdown:								
Influence on Landscape	X				X			
Influence on Surface Relief	X				X			
Influence on Biotopes	X				X			
Influence on Historical and Folklore Elements	X				X			
Imperviousness of Subsoil (permeability)	X	X	X		P			

EXHIBIT 4

SITE SELECTION CRITERIA IDENTIFIED BY CONTRIBUTING COUNTRIES

	FRG - Baden Wurttemberg	United Kingdom*	USA - California	USA - Illinois	USA - EPA Guidance			
Water Resources in Surrounding Areas	X	X		X	X			
Springs in Landfill Site Area	X	P						
Surface Water Drainage	X	X	X	X	X			
Flood Protection	X	P	X	X	X			
Expected Quantity of Percolating Water	X	X			X			
Possibility of Connections to Wastewater Treatment Plant	X							
Load Capacity of Recipient	X							
Wind Conditions	X							
Fog Incidents	X							
Inversion Hazards	X							
Dust and Aerosols	X							
Odorous Substances	X							
Noise Level	X							
Noise Peaks	X							
Impacts of Possible Cold Air Flow	X							
Capacity of Site to Abate Landfill Emissions	X							
Availability of Earth for Cover	X			X				
Suitability of Soil	X	X	X	X	X			
Work Space	X							
Fire Hazards	X							

EXHIBIT 4

SITE SELECTION CRITERIA IDENTIFIED BY CONTRIBUTING COUNTRIES

	FRG - Baden Wurttemberg	United Kingdom *	USA - California	USA - Illinois	USA - EPA Guidance			
Explosion Hazards	X							
Effective Porosity		X			P			
Landslide, Earthquake Hazards	X		X	X	X			
Traffic Accidnets	X				P			
Heavy Snowfall	X				P			
Military Operations	X							
Long-Term Maintenance:								
Settling of Landfill	X							
Leachate Presence and Treatment	X				X			
Surface Water Drainage	X		X		X			
Gas Drainage	X		X					
Gas Burning in Torches	X							
Precipition	P	P			X			
Erosivity					X			
Plasticity Index			X		X			
Liquid Limit			X					
Identification of Perched Water Table					X			
Grain Size			X		X			
Thickness of Soil								
Bedrock Type			X					
Topography					X			
Depth to Water Table		X		X	X			

EXHIBIT 4

SITE SELECTION CRITERIA IDENTIFIED BY CONTRIBUTING COUNTRIES

	FRG - Baden Wurttemberg	United Kingdom *	USA - California	USA - Illinois	USA - EPA Guidance			
Depth to Bedrock				X				
Ion Exchange Capacity of Soil		X		X	X			
Moisture Content, Field Capacity		X			X			
Transmissivity		X						
Storage Coefficients		X						
Discharge and Recharge Areas		X						
Dispersivity		X						
Landfill Liner				X				
OTHER CRITERIA FOR SITE SELECTION								
Cost of Disposal	X				X			
Cost of Transportation	X				X			
Cost of Site Modification to Meet Selection Criteria					X			

EXHIBIT 5

SITE SELECTION CRITERIA

IDENTIFIED BY THREE OR MORE

COUNTRIES

	FRG - Baden Württemberg	United Kingdom *	USA - California	USA - Illinois	USA - EPA Guidance
Effect on Drinking & Industrial Water Supply	X	X		X	X
Effect on Wastewaters & Percolating Water Drainage	X	X		X	X
Effect on Surface Water Drainage	X	X		X	X
Imperviousness of Subsoil (permeability)	X	X	X		P
Water Resources in Surrounding Area	X	X		X	X
Surface Water Drainage	X	X	X	X	X
Flood Protection	X	P	X	X	X
Expected Quantity of Percolating Water	X	X			X
Suitability of Soil	X	X	X	X	X
Landslide, Earthquake Hazards	X		X	X	X
Effect on Long-Term Surface Water Drainage	X		X		X
Precipitation	P	P			X
Depth to Water Table		X		X	X
Ion Exchange Capacity of Soil		X		X	X

* From hydrogeological criteria submitted. Planning legislation (not submitted) also deals with other site selection factors.

V. Long-Term Care

Several countries have begun to consider the long-term effects of placing hazardous wastes into what would presently appear to be secure landfill areas. What currently might seem to be a protected site may prove ultimately to be harmful to public health or the environment in the surrounding community in the future, as chemical changes occur in the landfill. The Federal Republic of Germany, the United Kingdom, and the United States have begun to take these effects into consideration with their comprehensive hazardous waste management plans. Discussed below are their respective current policies on long-term care.

Federal Republic of Germany

The complex licensing system of the FRG stationary waste handling, treatment, storage and disposal facilities is also intended to provide necessary long-term care of landfill sites. All relevant factors in the expected operations of the facility must be explained in the application for a license, then the plan undergoes a comprehensive procedure for approval.

The license applicant must provide the following information to the licensing authority: a detailed waste management plan, including expected quantity and quality of waste; a plan for measures such as landscaping, access roads, and groundwater and surface water protection; landfill operational plans; and, a description of machinery and personnel requirements. Also to be included in the application are contingency plans for operation under unfavorable weather conditions, pest control, fire protection, and deposition of sludges. Ground plans must meet State building regulations and expertise must be demonstrated for any planned earthen construction.

The licensing procedure can be divided into the following steps. First, a draft of the disposal plan is submitted to the State auditing authority. The auditing authority then distributes the plan to relevant authorities for comments on their areas of expertise that are included in the plan. The plan is then sent to affected communities to be displayed publicly for one month. After this period, for two weeks anyone can file objections with the auditing authority or community. An auditing session follows the expiration of the term for objections, where all objections are discussed in a formal proceeding similar to a court trial. The minutes from this auditing session, the plan, and comments from the auditing authority are then sent to the licensing authority.

The major task of the licensing authority is to decide on objections not settled during the auditing session. The authority must pass a resolution on the plan of establishment which has to be posted in the affected communities for two weeks. The resolved plan can be challenged in court by a law suit.

Once the disposal plan is approved, the problem of long-term care (e.g., of a landfill site) is assumed to be resolved, since the approved disposal plan includes long-term plans for recultivation and reclamation. In addition the conditions of a license can be modified by the supervising authority at any time later or the license can be revoked.

United Kingdom

Similar to the Federal Republic of Germany, the licensing system for the United Kingdom is designed to assure adequate long-term care of

a disposal site. The main task facing the waste disposal authorities is to assess the degree of risk associated with any site; a further consideration is whether or not to partly or wholly accept the risk; i.e., the waste disposal authorities should consider possible modifications to make the site acceptable.

A first requirement of the authorities is to have a complete description of the waste disposal facility. Items to be included are: past histroy, position in relation to other development, site conditions, hydrogeology, aquifer position, rainfall, leachate-prevention precautions, wetness of site, and location of treatment plants and transfer stations.

Once the facility itself is completely described, an assessment of the waste to be received at the site must be included in the license application. Of concern are the type of waste, the quantity of waste, and the expected mixtures of waste to be received. The resulting potential effects on the site must be described.

Two last areas of consideration are interaction with other applicable legislation and consultation with other relevant authorities--other authorities will require planning permission before a waste disposal license can be granted.

If the site becomes a hazard through a miscalculation on the part of the waste disposal authorities when granting a license, then it is anticipated that the matter will be settled in the court. In principle, liability for damage caused by contravention of license conditions falls to the operator, but the equities of the situation are ultimately settled by adjudication.

United States

In addition to a careful monitoring program, the United States believes that long-term care of disposal sites is an integral part of the financial responsibility of the owner. The Resource Conservation and Recovery Act of 1976 (Section 3004) requires regulations to be promulgated requiring "the maintenance of operation of hazardous waste treatment, storage, and disposal facilities...and requiring such additional qualifications as to ownership, continuity of operation, training for personnel, and financial responsibility as may be necessary or desirable."

Previous experience on the State level with the long-term care of waste storage and/or disposal is limited, but provision for long-term care is generally secured via a posted bond, a perpetual care fee, or a combination of both mechanisms. These alternatives, as well as the feasibility of a mutual trust fund for site operators, are discussed below. Also, the proposal to place a covenant on the waste site to transfer maintenance responsibility is presented.

One method of ensuring long-term site care is to require deposit of a cash bond or maintenance of a surety bond by the waste disposal site operator. A cash bond is defined here as an amount of money maintained in an account (usually with the government) for the purpose of securing adherence to certain procedures or regulations. A surety bond is a certain level of insurance maintained for the purpose of securing adherence to certain procedures or regulations. A performance bond is a cash or surety bond that is refunded after a certain period of time, given that the claimant has conformed with specified procedures or regulations, (e.g., acceptable methods of waste disposal, site construction,

monitoring, etc.).

The bond should be of sufficient size to assure proper site closure and site monitoring, surveillance, and maintenance for a number of years. The appropriate bonding level varies with site characteristics (size, geology, hydrology, etc.), the particular hazardous materials destined for disposal, and the degree of waste treatment prior to disposal. The likelihood of offsite damages (i.e., proximity to population centers, etc.) could be considered as well, although it has not previously been a factor, when choosing an appropriate bonding level. A surety bond would probably be less burdensome to the site operator than a cash bond of an equivalent amount. The premium paid for a surety bond would presumably be less than the cost of a loan needed for deposit of a cash bond.

In the case of a cash bond, adequate provision for perpetual site care is assured if the annual real rate of return (i.e., the return on the principal over and above the rate of inflation) offsets the cost of site upkeep. A portion of the bond could be used to correct major site deficiencies or to offset damages caused by leachate run-off or migration. Sufficient funds would have to remain in deposit to provide for annual site upkeep subsequent to such expenditures. If a change in site operators occurs (in advance of site closure), then the former site operator should be allowed to withdraw the bond's principal and the new operator required to deposit an equivalent amount.

An alternative to the required bond deposit is assessment of a perpetual care fee on each user of the waste facility. The user surcharge would be fixed on a volumetric basis. Site operators have not

allowed this fee to vary with the type of incoming waste. The aggregate fees are deposited in an account, and when a level sufficient to maintain long-term care of the site has been reached (including accrued interest), the fee may be discontinued. (Of course, the fee may be calculated such that the desired fund level will not be reached until the site is full.) The major drawback to this method of financing long-term site care is that the operator can cease site operations without having accumulated a fund large enough to assure adequate site closure and perpetual care.

Either a cash or surety bond can be combined with a perpetual care fee to provide for perpetual site care. A cash bond deposited with the State could be withdrawn when an equivalent amount accumulated through aggregate perpetual care fees has been deposited by the site operator.

Alternatively, a surety bond, equal to the difference between the apparent required sinking fund and the expected size of the sinking funds for that year (i.e., cumulative perpetual care fees plus accrued interest), could be required of the site operator. The apparent required sinking fund would be a site specific reserve sufficient to provide for routine maintenance, surveillance, and monitoring costs, as well as contingency funds in the event of major site repair. In essence, this method of assuring long-term site care would require the site operator to purchase declining term insurance to protect the State against early close-out of site operations.

A combined surety bond/perpetual care fee has been suggested as an adequate means of financial security for a low-level radioactive waste site. The apparent required sinking fund would be calculated on an annual basis, i.e., varying with the amount of waste deposited at the

site. An appropriate size for the contingency fund has been calculated on the basis of the "expected value" of major site repair costs (i.e., the sum of projected repair costs multiplied by their respective probabilities of occurrence). Alternatively, a contingency reserve sufficient to cover the estimated cost of major site repair, given the need for such action, could be required as part of the apparent required sinking fund.

Rather than accumulate a perpetual care fund for each disposal site, a mutual trust fund could be developed for all sites within a given jurisdiction (e.g., within a State). The proposal could be funded by any of the foregoing mechanisms. The trust fund would provide a large reserve to cover unexpected site repairs or damage claims. Also, due to the pooling of the risk of major site repair, the contingency reserve required of each site operator would be less than that needed if a separate sinking fund were maintained for each site. Private operators might not be as careful in site construction and maintenance if they are not directly liable for these costs, however. The enforcement agency would have to provide the incentive for continued site care.

One proposal for long-term site care suggested that a covenant be placed on the land which would prohibit the transfer of site maintenance responsibility with the deed unless the new owner accepted the responsibility and was capable of guaranteeing continued site mainterance. The question then arises of what constitutes capability to guarantee site maintenance; the owner would probably have to offer some sort of financial security.

A long-term care fund, similar to the alternatives just mentioned, might well have to be established. Thus, this method of ensuring long-term care is not really a discrete proposal, but rather a different context for posing the problem of adequate financial security for long-term care.

A combined surety bond/perpetual care fee appears to be an equitable and effective method of ensuring long-term site care. A mutual trust fund, pooling the risk of environmental damage and major site repair, could encourgae investment in the hazardous waste disposal industry. A trust fund should not be established unless there is strict enforcement of hazardous waste management regulations, however.

EEC

The EEC Draft Proposal for a Council Directive on Toxic and Dangerous Wastes envisages that the identification of the toxic and dangerous wastes remains possible where tipping is practiced. This implies that the location of all hazardous wastes in the landfill must be recorded.

Discussion

As in apparent from the contributions to the long-term care topic, this isa relatively undeveloped area of consideration by NATO countries. The total package for long-term care will necessarily include provisions fora physically secure site as well as financial arrangements for long-term care.

The Federal Republic of Germany and the United Kingdom are well on their way to technically guaranteeing safe sites via their complex licensing systems. But they have not made specific provisions for error in licensing judgement; i.e., long-term care programs generally do not yet include liability coverage for incidents. The question of who pays

for the error is subject to civil or administrative law regulations, as no financial provisions are included in the plans.

The United States is more contingency oriented; i.e., failure of a landfill is a major concern. Financial arrangements (bonds or fees) would provide money to close down a site as well as funds for long-term monitoring. By requiring some type of bond before licensing a site, a provision for technical error in evaluating a site is automatically built into the system.

In summary, it can be seen that mechanisms for long-term care are still being developed as essential elements in a comprehensive system for hazardous waste disposal. Very few NATO countries have experience with the licensing of landfills, and the United States is the only country currently considering financial arrangements to assure long-term care.

BIBLIOGRAPHY

Canada

Appended Seminar Proceeding Report; Procedures for the Analysis of Landfill Leachate, Environment Canada, EPS-3-SW-75-9, April 1975.

Denmark

Agency of Environmental Protection, Ministry of the Environment, Final List of Chemical Wastes, 1976.

EEC

Commission of the European Communities, Proposal for a Council Directive on Toxic and Danagerous Wastes, Brussels, July 22, 1976.

Federal Republic of Germany

Ahting, D., K. Hilger, and H.A. Helmy. Authorization Control Procedure for Special Wastes.

Association of Communal Transport Park and Public Cleaning Enterprises. Waste Disposal, Section 1720.

Abfall-Katalog der Informationsschrift Sonderabfalle. [Waste Catalogue.] 1975.

Bortlisz, J. Haus der Technik-Vortragsveroffentlichung, No. 283.

Federal Act of the Disposal of Wastes, June 7, 1972, and as amended, July 21, 1976.

Gesallschaft Deutscher Chemiker. Deutsche Einheitsverfahren Zur Wasser-, Abwasser-, und Schlammuntersuchung. [German Standard Procedures for Analysis of Water, Effluent, and Sludge.] 1972.

Kramer, F.J., M. Jacobs and R. Schweisfurth. Determining the Toxicity of Industrial Waste by Means of a Bacteria Test.

Manual on Hazardous Substances in Special Wastes, NATO/CCMS Document No. 55, April 1976.

Seng, Hansjorg. Standortbeurteilung bei Deponien. [Evaluation of Landfill Sites.] Mull und Abfall: Fachzeitschrift fur Behandlung und Beseitigung von Abfallen, pp. 148-157, May 1974.

France

Elimination des Dechets et Recuperation des Materiaux, Loi n° 75-633 du Juillet 1975.

Ministere de la Qualite de la Vie, Direction de la Prevention des Pollutions et Nuisances, Ordures Menageres--L'implantation d'un Centre de Traitment, SEMA Marketing et Modeles de Decision, Paris, Mars 1976.

Projet de Decret Fixant la Liste des Categories de Dechets Visces a L'article 8 de la Loi N° 75-633 du Juillet 1975, Juin 1976.

Netherlands

Chemical Waste Act. October 22, 1973.

Explanatory Memorandum No. 3.

United Kingdom

Control of Pollution Act, 1974

Department of Environment. The Licensing of Waste Disposal Sites Waste Management Paper No. 4, June 1976.

Gray, D.A., J.D. Mather and I.B. Harrison. Review of Groundwater Pollution from Waste Disposal Sites in England and Wales, with Provisional Guidelines for Future Site Selection. Hydeogeological Department, Institute of Geological Sciences, London, 1974. 25pp.

Statutory Instrument 1976, No. 732, The Control of Pollution [Licensing of Waste Disposal] Regulations, 1976.

United States

American Society for Testing and Materials. Annual ASTM Standards. Part 19, 1974.

California Department of Health. Hazardous Waste Management: Law, Regulations, and Guidelines for the Handling of Hazardous Waste. February 1975.

California State Water Resources Control Board. Waste Discharge Requirements for Waste Disposal to Land--Disposal Site Design and Operation. March 1975. 63pp.

Compilation of Methodology Used for Measuring Pollution Parameters of Sanitary Landfill Leachate. EPA Report EPA-600-/-3-75-011, U.S. Environmental Protection Agency, Washington, D.C.. 1975.

Farb, D.F. Chemical Waste Landfill Site Selection: A Review of Existing Approaches with Recommendations, U.S. Environmental Protection Agency, 1975. (Draft).

Kohan, A. Interim Policy Report on Provision for Long-Term Care of Hazardous Waste Disposal Sites. U.S. Environmental Protection Agency, March 1975. (Draft).

_____. Interim Policy Report on Public Acceptance of Hazardous Waste Management Facilities. U.S. Environmental Protection Agency, April 1976. (Draft).

Office of Solid Waste. Hazardous Waste Landfill Site Screening Criteria--Guidance Document. U.S. Environment Protection Agency 1976. (Draft).

Office of Technology Transfer. Manual of Methods for Chemical Analysis of Water and Wastes. U.S. Environmental Protection Agency, Washington, D.C., EPA Report EPA-625-1-6-74-003, 1974.

Piskin, R. Suitability of Landfills for Disposal of Hazardous Wastes in Illinois. Reprinted from Waste Age, 7(7): 42-52, July 1976.

Standard Methods for the Examination of Water and Waste Water, 13th edition. APWA, AWWA, APCF, American Public Health Association, New York, 1971.

Texas Water Quality Board Technical Guidelines. May 3, 1976.

U.S. Department of Agriculture, Soil Conservation Service. Guide for Interpreting Engineering Uses of Soils. U.S. Government Printing Office, Washington, D.C., Nov. 1971, 70 pp.

VI. Permit Processes - Rationale

The proper disposal of hazardous materials requires a total management approach that ideally answers the following questions:

A) What wastes will result from a proposed action?

B) Which of the possible disposal alternatives is most adequate for these wastes?

C) Is it possible to dispose of the wastes given the present and future restrictions on possible disposal alternatives?

It is necessary that decisions relevant to the disposal of waste be reviewed at all stages of production and handling. The decisions made prior to production are also very important. The following is a breakdown of the main areas where waste disposal decisions have to be made:

Hazardous Waste Disposal Decision Process

1. Pre-production decision
2. Generation
3. Transportation
4. Treatment
5. Disposal

Reasons for faulty decisions at these steps are:

a) The characterization of wastes is difficult and often neglected unless there is either a possibility of recovering valuable components as by-products or external controls requiring a degree of characterization outlined by some criteria.

b) It is not always possible to predict the nature of wastes produced before the generation phase in the case of new and non-routine processes.

c) Involvement by other parties than the producer often makes it difficult to determine the chemical composition of a waste, i.e., when a waste is turned over for disposal, the person receiving it is not generally given information as to what its chemical components are. Due to the fact that hazardous wastes have little, if any, economic value, the cheapest disposal alternative will normally be chosen, unless some external criteria influence the decisions, e.g., laws, public acceptance or known hazards, that could jeopardize public acceptance should they become known.

d) Due to the lack of an overall approach in environmental management, the best disposal option may not be utilized.

Briefly, it can be seen that this difficulty in following the above decision process is the fact that these decisions must be made considering the interdependence of:

a) Economics

b) Politics

c) Legislation

d) Technology

e) Public information, education and training.

As a result of these considerations, permit-type controls are required.

Two types of controls requiring permits are in use by many regulating agencies.

Permit Processes - Types

1. Permits for particular operation (plant, landfill, incinerator, etc.), "operation permit"
2. Control documents to maintain the identity of the waste (manifests, invoice, inventories, and labels); "trip ticket."

Facility Permits

It is not possible to design one permit that will suit all situations for the control of disposal facilities due to the variety of facilities and the different national and regional forms of legislation. It is generally recognized however that disposal facility performance permits are necessary to control:

a) facility safety

b) waste products allowed for disposal

c) facility capacity

d) disposal methods to be used for specific waste

e) effluent and emission criteria

f) record of wastes disposed of (particularly for land disposition of hazardous wastes for long-term control).

Control Documents

Unlike consumer products and industrial chemical commodities, the effort usually expended to maintain the identity of waste materials is often minimal unless identification control documents are mandatory.

Control documents are in general use and they are basically designed to maintain the identity of the waste and the generator.

The most useful control documents are:

a) "Trip Ticket" concept

b) Waste identification label.

"Trip Ticket"

This is a form of documentation designed to follow a waste from generator to transporter to disposer with a reporting mechanism to competent authorities.

As with the facility permits, the variety of regulation and laws that have led to the evolution of a trip ticket approach vary greatly with each regulatory agency. The aim, however, is to maintain a quantitative and qualitative monitoring of waste flows to various disposal facilities.

The trip ticket involves the transportation of hazardous wastes; its primary purpose is to maintain an interface between the various requirements of a total waste disposal system and to generate information for planning and surveillance purposes. It is therefore not satisfied by the normal manifest system of transport control agencies.

The most desirable system for transfer of information about wastes would combine the needs of transport authorities and transport controls with the needs of disposal authorities and disposal controls. The second most desirable form is a "trip ticket" or a manifest such as the California Liquid Waste Hauler Record of which a copy is attached. This form requires a fair amount of information to be provided by the producer of a waste, followed by information to be filled in, both by the hauler and disposer of the waste. A problem with this type of information-gathering is that it provides the disposer of a waste with information which may be considered confidential by the producer. This problem could be overcome by using a coding system administered by a regulatory agency. This would require that the regulatory agency assign a code number to the company and the nature of the waste, which would be relayed to the disposer along with disposal instructions.

In the FRG, a system of accompanying documents according to the administrative order on Notification of Wastes of July 29, 1974 shall enable the responsible authority to trace the path of notifiable wastes from their source to ultimate disposal. Copies of the notification forms enter the files of the authority as certificates on the orderly transport and disposal of the wastes. A joint Federal and State Committee on Waste Disposal edited, in 1975, a Waste Catalogue which is accepted nationwide and serves as a basis for the notification system, e.g., selection of notifiable wastes and application of uniform code numbers.

The simplest form of a trip ticket which would still retain the identity of the waste and the generator of that waste is a dual ticketing system whereby the generator of a waste signs the trip ticket along with the information required on the transport and disposal of wastes along with a second form where the transporter of the waste and the disposer of the waste in turn signs a second form. Such a form is in use in Ontario, Canada. A copy is attached.

In all three cases the important thing is that the identity of the waste be maintained from production to ultimate disposal and that decisions in hazardous waste disposal be controlled; a trip ticket is regarded as a valuable control tool.

Attached are examples of trip tickets either in force or proposed.

1. Province of Ontario Transfers of Liquid Industrial Waste Certificate, Ontario Regulation 926/76
2. California
3. FRG trip ticket

Revised December 1974

CALIFORNIA LIQUID WASTE HAULER RECORD

009- 051126

STATE WATER RESOURCES CONTROL BOARD
STATE DEPARTMENT OF HEALTH

PRODUCER OF WASTE (Must be filled by producer)

Name _____ CODE NO.
(PRINT OR TYPE)

Pick up Address: _____
(NUMBER) (STREET) (CITY)

Telephone Number: (___) _____ P.O. or Contract No.: _____

Order Placed By: _____ Date: _____

Type of Process which Produced Wastes: _____ CODE NO.
(Examples: metal plating, equipment cleaning, oil drilling – wastewater treatment, pickling bath, petroleum refining)

DESCRIPTION OF WASTE (Must be filled by producer)

Check type of wastes:

1. ☐ Acid solution
2. ☐ Alkaline solution
3. ☐ Pesticides
4. ☐ Paint sludge
5. ☐ Solvent
6. ☐ Tetraethyl lead sludge
7. ☐ Chemical toilet wastes
8. ☐ Tank bottom sediment
9. ☐ Oil
10. ☐ Drilling mud
11. ☐ Contaminated soil and sand
12. ☐ Cannery waste
13. ☐ Latex waste
14. ☐ Mud and water
15. ☐ Brine

☐ Other (Specify) _____ CODE NO.

Components:
(Examples: Hydrochloric acid, lime, caustic soda, phenolics, solvents (list), metals (list), organics (list), cyanide)

	Concentration: Upper	Lower	%	ppm
1.				
2.				
3.				
4.				
5.				
6.				

Hazardous Properties of Waste:
pH _____ ☐ none ☐ toxic ☐ flammable ☐ corrosive ☐ explosive

Bulk Volume: _____ ☐ gal ☐ tons ☐ barrels (42 gal.) ☐ other _____ (SPECIFY)

Containers: _____ (NUMBER) ☐ drums ☐ cartons ☐ bags ☐ other _____ (SPECIFY)

Physical State: ☐ solid ☐ liquid ☐ sludge ☐ other _____ (SPECIFY)

Special Handling Instructions (if any): _____

The waste is described to the best of my ability and it was delivered to a licensed liquid waste hauler (if applicable).

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

_____
SIGNATURE OF AUTHORIZED AGENT AND TITLE

HAULER OF WASTE (Must be filled by hauler)

CODE NO.

Pick Up: _____ Time: _____ ☐ am ☐ pm
(DATE)

State Liquid Waste Hauler's Registration No. (if applicable): 9

Job No.: _____ No. of Loads or Trips: _____ Unit No. _____

Vehicle: ☐ vacuum truck _____ barrels, ☐ flatbed, ☐ other _____ (SPECIFY)

The described waste was hauled by me to the disposal facility named below and was accepted.

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

_____
SIGNATURE OF AUTHORIZED AGENT AND TITLE

DISPOSER OF WASTE (Must be filled by disposer)

Name (print or type): _____ CODE NO.

Site Address: _____

The hauler above delivered the described waste to this disposal facility and it was an acceptable material under the terms of RWQCB requirements, State Department of Health regulations, and local restrictions.

Quantity measured at site (if applicable): _____ State fee (if any): _____

Handling Method(s):

☐ recovery

☐ treatment (specify): _____ CODE NO.
(EXAMPLES: INCINERATION, NEUTRALIZATION, PRECIPITATION)

☐ disposal (specify): ☐ pond ☐ spreading ☐ landfill ☐ injection well

☐ other (specify): _____ CODE NO.

If waste is held for disposal elsewhere specify final location: _____

Disposal Date: _____

I certify (or declare) under penalty of perjury that the foregoing is true and correct.

_____
SIGNATURE OF AUTHORIZED AGENT AND TITLE

The site operator shall submit a legible copy of each completed Record to the State Department of Health with monthly fee reports.

Reproduced from best available copy.

FOR INFORMATION RELATED TO SPILLS OR OTHER EMERGENCIES INVOLVING HAZARDOUS WASTE OR OTHER MATERIALS CALL (800) 424-9300

D.O.T. Proper Shipping Name

TRANSFERS OF LIQUID INDUSTRIAL WASTE

Ontario Regulation 926/76

PLEASE PRINT NUMBER

A

Company Name	
Address	
Description of Waste	
Quantity Kg (lb.), litres (gal.)	TIME OF TRANSFER day | mon. | year hr.am/pm
Transfer Location (if different from company address)	
Authorized company official: Name (please print)	Title:
Signature	Date:

B Disposal Site or Waste Management System

Method of treatment or disposal	
Certificate of Approval No.	DATE OF DISPOSAL Day | Mon. | Year

C Carrier

Name
Address
Vehicle Licence Plate No.
Date
Signature

D

Numbers from source forms	

MOE 1270 2/77

(Form to be in triplicate - 3 colours - with instruction on reverse side)

INSTRUCTIONS

1. WHEN A LOAD IS PICKED UP FROM THE SOURCE:

   a) THE CARRIER shall in Section C fill in his name, address, vehicle licence plate number, date and signature, and then give this form to an authorized person at the source.

   b) AN AUTHORIZED PERSON AT THE SOURCE shall fill out Section A of the form given to him by the Carrier, and mail the white copy to the Ministry. One copy must be retained by the source for a year.

---

2. WHEN A LOAD IS DELIVERED TO A DISPOSAL SITE OR WASTE MANAGEMENT SYSTEM:

   ON ANOTHER FORM THE CARRIER SHALL:

   a) In Section C fill in his name, address, vehicle licence plate number, date and signature, and;

   b) In Section D fill in the number of the form completed for each pickup comprising this load (See 1(a) above) and then,

   c) Give this form to the operator of the disposal site or waste management system.

   THE OPERATOR OF THE DISPOSAL SITE OR WASTE MANAGEMENT SYSTEM shall then fill out both Sections A and B of the form given to him by the Carrier, and mail the white copy to the Ministry. One copy must be retained by the operator for a year.

   NOTE: IF WASTE IS BEING TRANSFERRED FROM ONE CARRIER TO ANOTHER, it is the responsibility of the first carrier to provide the new form to the receiving carrier. The receiving carrier will write the number of this form in Section D of another form, for use when he subsequently transfers the waste.

---

3. WHEN A LOAD IS DELIVERED TO A SEWAGE WORKS:

   ON ANOTHER FORM:

   THE CARRIER shall fill out both Sections C and D and in Section A write the address of the Sewage Works, the description and quantity of the waste and the time of delivery; and mail the white copy to the Ministry. One copy must be retained by the carrier for a year.

---

4. MAIL THE WHITE COPY, BY THE LAST DAY OF EACH MONTH, TO:

   The Ontario Ministry of the Environment
   Pollution Control Branch
   135 St. Clair Avenue West
   Toronto, Ontario
   M4V 1P5

FRG Trip Ticket Omitted

1 INERT / INERTE

EALTH / NTE	FIRE / INCENDIE	ENVIRONMENT / ENVIRONNEMENT	REACTIVITY / REACTIVITE

ONTENTS / CONTIENT

SPOSAL / IMINATION | HANDLING / MANIPULATION

RIGINATOR / EXPEDITEUR | TEL. / TEL.

DATE

-1914 (01/77)

2 SLIGHT HAZARD / DANGEREUX

HEALTH / SANTE	FIRE / INCENDIE	ENVIRONMENT / ENVIRONNEMENT	REACTIVITY / REACTIVITE

CONTENTS / CONTIENT

DISPOSAL / ELIMINATION | HANDLING / MANIPULATION

ORIGINATOR / EXPEDITEUR | TEL. / TEL.

DATE

04-1914 (01/77)

3 HIGH HAZARD / TRES DANGEREUX

EALTH / NTE	FIRE / INCENDIE	ENVIRONMENT / ENVIRONNEMENT	REACTIVITY / REACTIVITE

ONTENTS / CONTIENT

SPOSAL / IMINATION | HANDLING / MANIPULATION

RIGINATOR / EXPEDITEUR | TEL. / TEL.

DATE

-1914 (01/77)

4 EXTREME DANGER

HEALTH / SANTE	FIRE / INCENDIE	ENVIRONMENT / ENVIRONNEMENT	REACTIVITY / REACTIVITE

CONTENTS / CONTIENT

Reproduced from best available copy.

DISPOSAL / ELIMINATION | HANDLING / MANIPULATION

ORIGINATOR / EXPEDITEUR | TEL. / TEL.

DATE

04-1914 (01/77)

HAZARD INFORMATION LABELS

VII. Labeling

Labeling plays an important role in the proper disposal of hazardous materials. Unlike consumer products or commercial commodities, there is very little incentive for labeling wastes. Yet, these wastes often will ultimately be handled by second or third parties and it is of prime importance to maintain the identity of:

a) the chemical constituents of the waste, and

b) the originator of that waste and his location, address or phone number.

It is also desirable that the container of a waste product indicate in some manner the nature and degree of hazard associated with the product, and any special handling and disposal procedures which may be required if the product is to be handled by second or third parties.

All containers of hazardous and toxic wastes processed by a facility and handled within that facility should be appropriately labeled. As a minimum, this label should indicate:

(a) producer's name and address

(b) description of contents

In addition, producers might be requested to provide a detailed description of the associated hazards, first-aid procedures, and handling and disposal procedures for the wastes, where this additional information is not on the original containers. It is desirable to keep a master file system that would contain this information for each type of waste handled.

It should be noted that there is a distinct difference in the applicability and function of a hazard information label and a transportation label. The two are and complementary and could possibily be combined. However, transportation labels will not be discussed in this section. A hazard information label developed for use in Canada will be described in detail as it is a useful link between a waste generator and a waste disposer. These labels are intended to be used only on small containers, not bulk shipment of waste.

Hazardous Information Labels - Environment Canada

The Hazardous Materials Management Division of Fisheries and the Environment Canada has developed a hazardous waste and identification labeling system which is presented here as an example of a label for hazard information. Four labels, examples of which are attached, with four distinctive fluorescent coloured strips (red, orange, yellow, green) are suggested, depending on the degree of hazard associated with the handling of the waste. This labeling system is used for identification of small containers, drums, and other discrete packages in Canada.

If the highest hazard for health, flammability, reactivity or environment is 4, a red label, which bears the warning "SEVERE HAZARD", should be used. If the highest hazard is a 3, an orange label which bears the warning "HIGH HAZARD", should be used. Similarly, if the highest hazard is a 2 or a 1, a yellow or green label with the words "SLIGHT HAZARD" or "INERT", respectively, should be used.

Below the hazard sign on each of the labels there are four white boxes to indicate the degree of hazard for each category. Below

this is a large box marked "CONTENTS" where the originator of the waste should indicate the contents of the container, including such relevant data as hazardous contaminants, nature of dilutants, special properties of the material that would make it particularly hazardous, and any other pertinent information. Below the "CONTENTS" box are two small boxes marked "disposal" and "handling" which should be filled with the number of the disposal procedure and the proper classification for handling as per UN system. The name of the originator of the waste, his location and telephone number and the date that the waste originated must be entered in the lower-most area of the label.

Responsibility

The individual user should be responsible for placing hazardous and toxic wastes in proper containers and for correctly labeling the containers as to the degree and nature of hazard and required disposal method.

Hazard Levels

The hazards of each substance are identified using four broad categories:

Health,

Flammability,

Reactivity,

and

Environment.

Assigned ratings in each of the four categories of health, flammability, reactivity, and environment, are from 1 to 4 in order of increasing severity:

Rating 1 - inert or no hazard

Rating 2 - slight hazard

Rating 3 - high hazard

Rating 4 - severe hazard

(1) Health Hazards

A health hazard is any property of a material which either directly or indirectly can cause injury or incapacitation to humans, either temporary or permanent, from exposure by contact, inhalation, or ingestion.

Rating 1 Inert or No Health Hazard: No known health hazard.

Rating 2 Slight Health Hazard: These are substances which have vapours which are unpleasant at high concentrations, liquids or solids which can cause burns on long exposure, or substances which can be toxic in large concentrations in inhalation, absorption, or ingestion.

Rating 3 High Hazard: Substances which, on prolonged or repeated exposure, may cause serious injury or have significant residual detrimental effect.

Rating 4 Severe Health Hazard: Substances which, on short exposure, may cause death or major injury.

(2) Flammability

This characteristic is related to the ease with which a substance may be ignited and undergo combustion or oxidation. Vapours and gases form mixtures in air or oxygen. Upper and lower concentration limits exist above and below which propagation of flame does not occur with the introduction of a source of ignition. However, between these limits the mixtures will be flammable, and combustion may take place with explosive violence.

Rating 1 Inert - No Flammability: Substances which will not readily burn.

Rating 2 Slight Flammability: Substances that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur.

Rating 3 — High Flammability: Liquids and solids that can be ignited and burn readily under almost all ambient temperature conditions.

Rating 4 — Severe Flammability: Substances which will rapidly or completely vaporize or readily disperse in air at normal atmospheric pressures and ambient temperatures and which will burn readily.

(3) Reactivity (Stability)

This characteristic deals primarily with the susceptibility of materials to release energy by decomposition, by self-reaction or by reaction with other materials. Reactions with oxygen (oxidation) are excluded and covered under flammability.

Rating 1 — Inert - No Reactivity: Substances which are normally stable.

Rating 2 — Slight Reactivity: Substances which undergo mild reactions that are unlikely to be hazardous.

Rating 3 — High Reactivity: Substances which are capable of detonation or explosive reactions with other substances but require a strong initiating source such as heating under confinement.

Rating 4 — Severe Reactivity: Substances which are readily capable of detonation or of explosive decomposition or reacting violently with other substances at normal temperatures and pressures.

(4) Environmental Hazard

The environmental hazard of a substance is measured in terms of its adverse effects on both plants and animals, as appropriate, in land, water, or air habitats.

Rating 1 — Inert - No Environmental hazard: Substances which can be disposed of in commonly used facilities, for example, municipal facilities.

Rating 2 — Slight Environmental Hazard: Substances which, when applied intensely or continuously could cause possible residual damage unless the exposure is discontinued.

Rating 3 — High Environmental Hazard: Substances which could cause serious damage.

Rating 4 — Severe Environmental Hazard: Substances which cause major residual damage.

VIII. Facility Safety

As noted previously in the "Facility Permits" section, some aspects of facility safety are covered in permit provisions. In theory the safety precautions and procedures of a hazardous waste disposal facility should be the same as any chemical plant or laboratory that handles hazardous wastes.

The fact is, however, that there is a much greater degree of uncertainty in the handling of hazardous materials at a disposal facility due to the fact that the wastes and their containers are of no economic value and therefore the most efficient method of handling is to combine a large number and variety of waste in a limited number of disposal methods. The success of this approach will depend on the experience and expertise of the supervisors and handlers of wastes at these facilities.

In anticipation of unknown hazards such as gas evolution, toxic vapours, flash fires and explosion, and unintentional reaction, the personnel at a hazardous waste disposal facility should have on hand equipment to handle accident situations that would not normally be anticipated in normal waste disposal facilities. Personnel should be trained in first aid and emergency procedures.

Before treating any wastes, the personnel must be totally aware of the nature of the specific constituents of the waste and have at their disposal prescribed precautions and an analytical capacity to verify composition of the waste either on the premises or elsewhere.

Personnel protection must be provided, and depending on the particular hazards involved, might include rubber suits, rubber gloves (light and heavy), hard hats, face shields, self-contained breathing apparatus, ropes and safety belts, rubber knee boots with safety soles and toes, first-aid kits, tools for opening containers, and in some cases remote controlled tools for opening containers and oxygen resuscitation equipment.

The emergency agencies such as the fire departments and police departments should be alerted to the nature of the operations taking place and be notified of the emergency procedures to be followed in case of accidents at the facility. The management of the facility should also initiate a safety program and have an emergency response team for emergency situations.

When personnel are authorized to work alone and, even when in pairs, communications should be available at all times.

It is extremely important that a professional supervisor be aware of the operations taking place in a disposal facility, and that personnel do not handle any material or start any process that they are not entirely familiar with. Therefore when a disposal facility receives a waste or contemplates receiving a waste which they are not familiar with, laboratory and small-scale testing of disposal procedures should be mandatory.

In summary, it can be said that the technology and techniques for handling hazardous wastes are essentially the same as handling other hazardous commodities, but the degree of uncertainty is much greater and therefore, a proportionate increase in safety precautions should be taken at hazardous waste management facilities.